PD-ABM 389
97847

FINAL REPORT
FARMING SYSTEMS RESEARCH

by

DR. M. QASIM CHATHA

DR. AMAN ULLAH CHEEMA

Mr. M. I. SULTANI

DR. SHAHID M. ZIA

NATIONAL AGRICULTURAL RESEARCH CENTRE

PAKISTAN AGRICULTURAL RESEARCH COUNCIL

ISLAMABAD.

JULY, 1994

ACKNOWLEDGEMENTS

ACKNOWLEDGEMENTS

We feel great pleasure in expressing the deepest sense of gratitude to US-AID and Winrock International for their financial and technical support to FSR Programme. We wish to extend our sincere thanks to Dr. Bill C. Wright, Dr. Murray D. Dawson, Dr. Takumi Izuno and other short term local and expatriate consultants for their guidance in successful execution of the programme.

We are grateful to Dr. Zafar Altaf, Chairman, PARC for his administrative support, and continuous encouragement. We are also thankful to Dr. Muhammad Akbar, Director General, NARC and Dr. Muhammad Hanif Qazi, Member (Crop Sciences), who have been always helpful and supportive in smooth running of the programme.

We sincerely record our indebtedness to all collaborating scientists, Agri. Extension Departments for their inspiring efforts, sympathetic attitudes, commitments and dedications. Our special thanks and appreciations are extended to the farmers whose cooperation and interest was remarkable and without their participation this programme might have not achieved the success. We also wish to extend our thanks to all the NARC Coordinators who provided their generous support in making this programme a success.

We will be failing in our duties if we don't acknowledge the contributions of PS, MART and all those provincial as well as local Heads of respective Departments/Ministries who have been instrumental for the smooth running of the FSR programme under all the circumstances.

We are especially thankful to our present and previous FSR technical and supporting staff who significantly contributed and took active part for efficient and smooth execution of the programme. Our thanks are due to Mr. Zahoor Ahmad and Ms. Uzma for their excellent word processing and composing work.

Once again we offer our thanks and gratitude to all our colleagues at NARC and partners in the provinces whose help made it possible to give this report a final shape.

TABLE OF CONTENTS

1. List of tables i

2. Executive summary v

3. Introduction 1

4. Constraints and interventions: 5

- Ayub Agricultural Research Institute, Faisalabad. 6
- University of Agriculture, Faisalabad. 7
- Sindh Agricultural University, Tandojam. 8
- Agricultural Research Station, Dhodial, Mansehra. 9
- Agricultural Research Institute, Quetta. 10
- National Agricultural Research Centre, Islamabad. 11

5. Achievements:

- Ayub Agricultural Research Institute, Faisalabad. 12
- University of Agriculture, Faisalabad. 29
- Sindh Agricultural University, Tandojam. 33
- Agricultural Research Station, Dhodial, Mansehra. 42
- Agricultural Research Institute, Quetta. 49
- National Agricultural Research Centre, Islamabad. 58

6. FSR Publications/Trainings. 72

7. Benefits to the farmers. 77

8. Lessons learned. 81

9. Apendix-I 84

LIST OF TABLES

LIST OF TABLES

S.No.	Contents	Page No.
1.	Effect of improved variety of rice on performance.	13
2.	Introduction of mungbean in rice-wheat system.	15
3.	Zero-tillage wheat technology and its comparison with farmer's practices.	17
4.	Survival of rice stem borer larvae in different tillage systems in FSR project area, Shahkot.	18
5.	A comparison of conventional and improved wheat planting systems.	20
6.	Chemical weed control in carrots.	22
7.	Chemical weed control in peas.	23
8.	Chemical weed control in wheat.	23
9.	Average wheat grain yield as effected by the application of micronutrients.	25
10.	A comparison of wheat relay cropping with sequential cropping.	26
11.	A comparison of surface seeding of wheat with conventional method in rice-wheat system.	27
12	A comparison of direct seeding with transplanting of rice.	28
13.	Average daily feed intake, and milk yield of cows fed on different regimes.	29
14.	Performance of sorghum sadabahar' as a multicut fodder.	30

S.No.	Contents	Page No.
15.	Yield of Mott grass fodder.	31
16.	Average milk production and feed consumption of animals fed on different regimes.	32
17.	Economic benefits of deworming in sheep.	32
18.	Yield of cotton (kg/ha) obtained through improved practices at Hala site during 1991-92.	37
19.	Grain and straw yield (kg/ha) of wheat obtained under minimum tillage practice at Hala site during 1991-92.	38
20.	Effect of variety and N:P fertilizer on yield of mungbean (kg/ha).	39
21.	Average maize grain and stover yield (T/ha) with farmer's and improved technology.	43
22.	Effect of hand weeding and chemical weed control on maize grain and stover yield (T/ha).	44
23.	Economic analysis of hand weeding vs chemical weed control in maize.	44
24.	Effect of different pollinating varieties on apple fruit setting (number of fruits/plant).	45
25.	Effect of parasite control on the productive performance of sheep and goats.	46
26.	Productive performance and economic analysis of oats and wheat as fodder.	47
27.	Productive performance and economic analysis of desi vs fumi breed of poultry.	48

S.No.	Contents	Page No.
28.	Average yield and economic return from onion under improved and farmer's practice at six locations.	50
29.	Green fodder yield and economic return from improved and farmer's variety of lucern at various locations in Kanak Valley 1991-92.	51
30.	Wheat yield and economic return recorded under improved and farmer's package of technology at Kanak Valley 1991-92 (average of seven locations).	52
31.	Average yield and economic return from apples under improved and farmer's pest management.	54
32.	Average yield and economic return from apple orchards (three sites) under pruning and proper pest management and un-pruning and farmer's pest management techniques.	55
33.	The effect of benlate and topsin on wilt disease and cumin yield at Kanak valley during 1991-92.	56
34.	Comparison of improved and existing versions of maize technology in Gujar Khan Tehsil 1993.	58
35.	Comparison of various maize production components in Gujar Khan Tehsil 1993.	59
36.	Average wheat and mustard (fodder) yields (kg/ha) during 1988-89 to 1992-93 in Fatehjang and Gujar Khan rainfed areas.	60
37.	Average net return from wheat and mustard fodder under different treatments (Rs/ha) during 1988-89 to 1992-93.	60
38.	Yield and economic benefits with introduction of fodder oats.	61

S.No.	Contents	Page No.
39.	Effect of various interventions on soil nutrients status.	65
40.	Effect of supplemental feeding on live weight gain of ewes and their lambs.	67
41.	Partial budget analysis of live weight gain in lambs from ewes fed at different levels of supplemental ration.	68
42.	Cost and returns of hens reared by sample group for 6 months.	70

EXECUTIVE SUMMARY

Farming System Research (FSR) programme was launched in 1987 under USAID funded MART project. The objective of the programme was to enhance farm productivity through multidisciplinary team efforts. It was a coordinated programme with its headquarter at NARC and Coordinating Units in all the four provinces of Pakistan. It was a bottom up approach and farmers were fully involved in the process of technology transfer like planning and execution of the FSR activities. Similarly the involvement of Agricultural Extensionists was envisaged in the work plan. The programme ended in June, 1994.

To start with, several training courses were carried out for the FSR scientists, to acquaint them with the concept of FSR and its methodology; such as, site selection, diagnostic survey techniques, execution of the activities, collection and analysis of data and finally, interpretation of data and preparation of reports, etc. About 25 scientists were trained.

Each unit formed multidisciplinary teams which followed typical FSR approach for identifying farm problems/constraints of productivity and their possible solutions. The interventions were then tested on farmer's fields and validated technologies were disseminated through extension agencies.

Several activities were carried out by federal unit in collaboration with almost all commodity and livestock programmes at NARC. Consequently, new varieties of wheat, maize, sorghum, oats, canola, pulses and mustard fodder were introduced to enhance productivity. The results were encouraging and a wide adoption was observed by the farmers of Pothowar area.

Under Agro-forestry Programme of NARC, 21 thousand saplings were planted and more than 300 farmers and school boys were trained in nursery raising. Establishment

of multi-purpose tree nurseries on the principle of participatory approach are under way in the FSR target areas. To improve animal nutrition and health, supplemental feeds and mineral mixture was introduced and vaccination and deworming programmes were undertaken.

As one of the coordinating programmes at NARC, Transfer Technology unit played an instrumental role in disseminating validated technologies by organizing colloquial and field days. Efforts were also made to develop local entrepreneurs for sustained availability of key inputs.

In Punjab, wheat sowing, generally gets delayed due to late harvesting of previous crops like rice and cotton. The technologies identified by Punjab unit at AARI, Faisalabad, helped timely wheat planting with zero till drill after rice and relay wheat cropping in cotton. These technologies helped in increasing the productivity of wheat in these areas. The economic conditions of the farmers improved through increased yield and reduced production cost. Similarly, they introduced mungbeans and sesame in wheat-rice system, leading to increased productivity and economic benefits in this system.

Through the efforts of the Punjab unit at University of Agriculture Faisalabad, Mott grass and sorghum 'Sadabahar', multicut fodder species, were popularized successfully among the farmers. Wheat 'bhusa' enriched by urea treatment feed and mineral mixture supplementation were demonstrated to livestock producers which improved the growth, sexual maturity, calving interval and conception rate of animals. A large scale deworming and vaccination programmes were launched by this unit which greatly improved the health of animals in the target area. In order to up grade the skill in livestock and poultry management; extension officers and farmers were trained in this field. More than 50 farmers days were organized in the FSR target areas where appropriate technologies to treat the industrial byproducts and waste were demonstrated which were commercially and economically viable. The same unit

sponsored several post graduate students to undertake research on citrus pulp as potential source for feeding dairy heifers and use of iple iple as a feed source for large and small ruminants.

In Baluchistan, FSR unit introduced new varieties of onion, fodder (lucern) and wheat alongwith improved package of production technology. Consequently, substantial increases in the yields of these crops were obtained. Quality and yield of apples was improved considerably by adoption of pest control techniques and pruning methods. The unit trained farmers in various plant management technique such as pruning, pest control and better management of irrigation water through improved basin irrigation system.

The NWFP unit at Mansehra, achieved 50% increase in maize yield in this area by introducing an improved maize variety Azam and advocating the use of recommended doses of fertilizer. The unit also disseminated the technique for using Pollinator varieties of apple in the area for maximizing fruit production in self-incompatible varieties. For an increase in the fodder production and farmer's income, oat crop was popularized in this area by this unit.

In Sindh, FSR unit made a remarkable achievement through improved wheat varieties and improved fertilizer use technology in Tando Muhammad Khan and Hala areas. Similarly, cotton yield was increased by 15.30%. The unit also introduced mungbean and soybean crops in the target areas. However, soybean could not be popularized due to its market problem in the area. Minimum tillage practice introduced by the unit increased the yield of subsequent wheat crop planted after onion. Introduction of multi-cut Mott grass fodder was found beneficial during the scarcity period and increased milk production in the area. Introduction of intercropping of onion in sugarcane was an other achievement of this unit with cost-benefit ratio of 1:2.4. The seed of improved varieties of wheat, cotton, rice and mungbean was produced in large quantities by the farmers themselves for its

distribution among the farmers of target areas.

A total of 44 interventions verified at all the FSR target sites. Out of these 31 interventions are being extensively used by the farmers. According to an estimate, 21321 farmers were involved and 16094hectares were brought under improved FSR technologies. Under livestock sector 20712 animals were served for preventive disease measures and with feeding practices to improve their health. As a results of benefits of these interventions a total Rs. 56.485 million earned by the farming communities in the FSR and adjoining areas.

In view of the outstanding achievements through FSR approach it was realized that FSR needs to be institutionalized on sound footing with our own resources so that the FSR activities should be continued after the termination of MART project. However, due to financial constraints the idea could not be materialized except introduction of courses on FSR Departments of Agricultural Economics, and Livestock Management at the University of Agriculture, Faisalabad.

INTRODUCTION

In Pakistan Farming System Research (FSR) Programme was established in 1987 under the USAID funded MART Project. The objective of the progarmme was to increase the productivity and maximize net farm income through establishing multidisciplinary teams of scientists who should work with the farmers. FSR approach was entirely different than commodity oriented research programmes. It dealt with all the resources of the farmers viz crops, animals and also suggesting them to enhance their income through adopting agro-forestry techniques/interventions. It was a new way, looking as a holistic view of farm operations and was a farm-oriented, seeking answers to constraints/problems of the farmers which are limiting the farmer's productivity and ability to make best use of his land, water, energy and labor resources. The programme ended in June, 1994.

FSR was a coordinated programme with headquarter at NARC and two units in Punjab and one unit each in NWFP, Sindh and Baluchistan. There was no provision of staff in FSR Programme. However, coordinating unit at national level was established by borrowing few scientists from other disciplines/programmes either on full time basis or on part time basis. At provincial levels 2 to 3 scientists were appointed in FSR units on a part time basis. The supporting staff (Drivers/Office Asstt./Typist) was engaged on contract/contingent basis.

At national level about a dozen programme of NARC were involved in FSR activities. A scientist of each programme was designated to work with FSR Programme on part time basis.

As per mandate of FSR the women component for uplift of women folk was equally important. But somehow or other this component was not well established except at national level. Similarly, the Agricultural Extensionists were supposed to be closely linked and take active part in FSR activities, but, again the linkage remained very

poor except at national level and one or two locations in the provinces. However, what ever relations/linkages were established with extension at these locations were far below the expectation as envisaged in the work plan.

The FSR target sites and implementation agencies are given as under.

Institution/agency	Implementation Institution		Target sites
Pakistan Agricultural Research Council, Islamabad	National Agricultural Research Centre, Islamabad	-	Fateh Jang
		-	Gujar Khan
Punjab:			
Ayub Agricultural Research Institute, Faisalabad	Agronomy Directorate	-	Shahkot,
		-	Gujranwala
		-	Gojra
University of Agri. Faisalabad	Livestock Management Department	-	Proka,
		-	Shahkot
		-	Lalian
		-	Gojra
Sindh:			
Sindh Agri. University Tandojam	Soil/ Horticultural Department	-	Hala
		-	Tando Muhammad Khan.

Institution/agency	Implementation Institution	Target sites
NWFP:		
NWFP Agri. University, Peshawar	Agricultural Research Station, Dhodial (Mansehra)	- Pakhal Plain - Chattar Plain - Mansehra Rural
Baluchistan:		
Agricultural Research Institute, Sariab Quetta	ARI, Sariab	- Kanak Valley - Khad Koocha valley.

METHODOLOGY

a) Compilation of Secondary Data:

Secondary data on important aspects (such as land utilization, cropping patterns, production trends and natural and socio-economic environment) of the target areas were compiled and reviewed. This helped to understand the situation of the area as background of the survey.

b) Informal Survey

Primary data were collected through informal diagnostic surveys carried out in each target site. The survey methodology followed methods developed in several farming system research programmes. It has proven a powerful technique in obtaining a rapid

understanding of local farming systems and identifying priority research opportunities. Interviews were conducted informally and in a relaxed manner with farmers and groups of farmers. A questionnaire was not used in the survey, however, effort was made to note the frequency of farmers with specific characteristics or using particular practices. To help the researchers in the interviews, a detailed set of guidelines was prepared before the survey which were continuously revised to incorporate questions on issues emerging during the survey. The length of interviews ranged from a few minutes to an hour or more for in depth discussions on farmers' decision criteria, depending on the farmer's own interest and time. Over 100 farmers were interviewed from sample villages in each FSR target area. A random sampling method was not used to select farmers. However, an effort was made to interview a representative cross-section of farmers in villages along main roads and in more remote areas.

A multi-disciplinary team of social scientists (agricultural economists, rural sociologists and anthropologists) and biological scientists (agronomists and plant pathologists) was employed. Livestock scientists also participated in the survey. Each day three to four teams consisting of one/two social scientist(s) and one or two crop scientists were formed.

Interviews were not only restricted to farmers. Other persons knowledgeable of agriculture such as grain and `bhoosa' merchants, agricultural officers, input suppliers - both private and public - and bankers were also interviewed. In addition, direct field observations of variables such as stand establishment, weeds, moisture and fertility problems were taken. Efforts were made to understand difference in crop performance between adjacent fields.

CONSTRAINTS AND INTERVENTIONS:

From the information collected through diagnostic surveys of the project areas, carried out in 1987 and supplemented through later contacts and farmer interviews, the FSR multidisciplinary teams identified many constraints limiting production. These constraints were prioritized according to their importance and availability of technological components.

The interdisciplinary teams of scientists suggested and planned various interventions through discussions, keeping in view the identified production problems. These production problems alongwith suggested potential solutions/interventions for each target site are enlisted on the following pages.

AYUB AGRICULTURAL RESEARCH INSTITUTE, FAISALABAD.

S.No.	Production problems		Suggested potential solutions
1.	Low crop yields due to	1.	The following interventions were introduced to improve productivity.
i)	Weed infestation.	i)	Weed control by chemical and cultural practices.
ii)	Delay in wheat sowing.	ii)	Improving rice-wheat system through early Variety Basmati-385.
iii)	Cultivation of inferior varieties susceptible to diseases and insect pests.	iii)	Varietal evaluation trials.
2.	Limited irrigation water and high input prices.	2.i)	Introduction of crops with less water requirements like lentils and gram.
		ii)	Improved management practices.
		iii)	Low cost technology.
3.	Low farm income.	3.i)	Improved cropping intensity in certain areas.
		ii)	Intercropping pulses, vegetables and oilseeds in sugarcane.
4.	Low productivity and poor health of farm animals.	4.i)	Health cover.
		ii)	Introduction of cheap and cost efficient feed.
5.	Ineffective extension services.	5.	Meetings with the farmers to create awareness about improved technology.

UNIVERSITY OF AGRICULTURE FAISALABAD, PROKA/SHAHKOT

S.No	Production problems		Suggested potential solutions
1.	Out-moded fodder varieties.	1.	Introduction of improved fodder varieties Sadabahar and Mott grass.
2.	Poor feed resources and thus the productivity of animals was low.	2.i)	Feeding of tree leaves/shrubs/grasses.
		ii)	Enrichment and preservation of straws and surplus fodder.
		iii)	Introduction of cheap livestock feed.
3.	Shortage of canal water, poor land levelling and water management.	3.i)	Water use efficiency. Replacement of puddling by surface compaction.
		ii)	Furrow bed sowing technique on irrigation water use efficiency and crop yield.
		iii)	Land levelling.
4.	Parasitic (endo/acto parasite) infestation in small and large ruminants.	4.	Deworming vaccination of small ruminants.
5.	Low productivity and late sexual maturity due to mineral deficiency.	5.	Effect of feeding mixture on sexual maturity of heifers and productive performance of lactating animals.

SINDH AGRICULTURAL UNIVERSITY, TANDOJAM, HALA/TANDO MUHAMMAD KHAN.

S. No.	Production problems		Suggested potential solutions
1.	Poor quality seed (wheat, rice, cotton and mungbean).	1.	Introduction of pure seed of high yielding varieties of cotton (NIAB-78), wheat (Sarsabz) and mungbean (20-21).
2.	Inadequate application of fertilizer.	2.	Recommended doze of N.P. &. K fertilizers.
3.	Improper pest management.	3.	Introduction of proper doses of insecticides/pesticides.
4.	Low productive performance of livestock due to malnutrition/fodder shortage.	4.i)	Introduction of hay/silage preparation during surplus supply period.
		ii)	Introduction of high yielding fodder varieties.
5.	High mortality and morbidity losses due to infectious diseases and endo/ acto-para sites.	5.i)	Vaccination against infections diseases.
		ii)	Deworming against parasites as per schedule.
6.	Lack of extension services:	6.i)	Creating awareness among farmers about technologies through field days/workshop.
		ii)	Motivation and mobilization of existing resources.

AGRICULTURAL RESEARCH STATION, DHODIAL, MANSEHRA, PAKHAL VALLEY.

S. No.	Production problems		Suggested potential solutions
1.	Low yield of soybean due to low seed rate, high weed density.	1.	Introduction of cultural practices to reduce weed density. Recommended seed rate was used to increase the yield.
2.	Low yield of rapeseed due to un-improved local seed and no use of fertilizer.	2.	Improved seed rapeseed variety Pak-China-89 and recommended dose of fertilizer were introduced.
3.	Low maize production due to use of local variety and less fertilizer.	3.	Introduction of improved maize variety Azam and recommended use of fertilizer.
4.	Low farm income due to low value crops.	4.	Introduction of soybean into wheat-maize-wheat and lentils into maize-fallow-maize systems.
5.	Low yield due to weeds infestation.	5.	Use of cultural practices and selective herbicides in maize, soybean, wheat and lentil.
6.	Core rot disease incidence in apple orchards.	6.	Application of micronutrient and fungicides to control core rot disease of apple.
7.	Heavy losses of the onion crop due to severe attack of downy mildew disease.	7.	Chemical control of downy mildew disease.
8.	Unfruitfulness in apple.	8.	To provide the source of compatible pollen to self incompatible apple variety.
9.	Slow growth and lower egg laying performance of local poultry breed.	9.	Introduction of improved poultry breed.
10.	High mortality and low milk/ meat production in livestock.	10.	Vaccination against fatal diseases and contorl of endo/acto parasites in small and large ruminants.

AGRICULTURAL RESEARCH INSTITUTE SARIAB, QUETTA-KANAK VALLEY.

S. No.	Production problems		Suggested potential solutions
1.	Lower yield of wheat, onion, potato and lucern crops.	1.	Improved varieties and balanced fertilizer application.
2.	Low productivity of apple orchards mainly due to: productivity.	2.	The following interventions were introduced to improve the apple orchards
i)	No use of trees pruning methods.	i)	Farmers training about pruning techniques.
ii)	Pesticides are applied injuriously.	ii)	Appropriate doses of pesticides after careful monitoring of pest in orchards.
iii)	In appropriate use of scare and costly irrigation water.	iii)	Management of irrigation system by employing modified basin system.
iv)	Bark splitting disease.	iv)	Use of fungicides cobox, trimil and tox-forte to control the disease.
3.	Low productivity of small ruminants due to poor nutritional status and health coverage.	3.	Flushing of breeding stock, vaccination and deworming of small ruminants.

NATIONAL AGRICULTURAL RESEARCH CENTRE, ISLAMABAD, FATEHJANG/GUJAR KHAN.

S. No.	Production problems		Suggested potential solutions
1.	Low cropping intensity	1.	Introduction of mungbean/soybean/ sunflower into the existing wheat-fallow-wheat system.
2.	Low yield of chickpea.	2.	Introduction of improved variety seed (CM-72).
3.	Low yield of lentil.	3.	Introduction of improved seed (Manshera 89) and recommended dose of fertilizer.
4.	Use of local out moded varieties of mustard mixed in wheat.	4.	Introduction of high fodder yielding good quality and palatable mustard variety S-9.
5.	No use of fertilizer and low fodder yielding sorghum varieties.	5.	Introduction of high fodder yielding, drought tolerant and good quality and sorghum variety with recommended fertilizer application.
6.	Low maize grain yield due to high plant density and local variety seed and low fertilizer use	6.	Introduction of seed of improved variety and recommended plant population and fertilizer.
7.	Accelerated soil erosion, shortage of forage, fuel wood and timber.	7.	Introduction of drought tolerant multi-purpose tree species.
8.	Poor productive performance of livestock.	8.	Supplementation of blended feed
		ii)	Introduction of mineral mixture.
		iii)	Enrichment of crop residue with urea (ammonia) treatment.
9.	High mortality and morbidity losses due to infectious diseases and endo/ acto parasites.	9.	Vaccination and deworming of livestock as per schedule.

ACHIEVEMENTS

AYUB AGRICULTURAL RESEARCH INSTITUTE, FAISALABAD.

IMPROVEMENT OF RICE-WHEAT SYSTEM IN SHAHKOT AREA.

Wheat is a major crop of rabi season and about 50% is sown after rice. Common cultivated rice varieties i.e. Basmati-Pak and Basmati-370 are long duration and mature late. Thus, wheat sowing is delayed and wheat yields are decreased substantially. Introduction of an early maturing, fine rice variety Basmati-385 seemed possible.

In the improved system, an early maturing, short duration variety Basmati-385 was sown while in the traditional system variety basmati-Pak was used. After harvesting the rice crop, wheat was sown in the same fields. As basmati-385 was harvested about 16 days earlier than Basmati-Pak the farmer was able to sow his wheat crop about two weeks earlier in the improved system. The whole system was studied carefully during 1987-88 and 1988-89 and yield data were collected by taking samples from both the systems.

The yield data are summarized in Table 1. It was observed that Basmati-385, in both the years, produced significantly higher grain yield and matured earlier, as a result, wheat yield was significantly increased. On an average, the wheat yield was 26.81% higher than farmer's practice.

Table 1: EFFECT OF IMPROVED VARIETY OF RICE ON PRODUCTION.

Partial budgeting		Improved system (Basmati-385)	Traditional system (Basmati-Pak)
Adjusted grains yield of Rice (T/ha)		4.05	3.69
Adjusted grain yield of wheat (T/ha)		2.51	1.89
Field price (Rs/kg)			
Rice	(Grains)	2.95	3.20
	(Straw)	0.20	0.25
Wheat	(Grains)	1.50	1.50
	(Bhoosa)	0.30	0.30
Gross benefit (Rs./ha)		47275.50	16132.50
Variable cost (Rs./ha)			
Cost of seed.		44.00	39.00
Return above variable cost (Rs/ha)		17231.50	16093.50
Increased benefit (Rs/ha)		1138.00	-
Increased benefit (%)		7.08	-

It was further observed from the economic analysis that farmer's net benefit was increased by about 7%.

The farmers were benefitted in two ways due to introduction of the Basmati-385. Firstly, rice as well as wheat yields were increased which contributed to higher net farm income. Secondly, the wheat area was increased as the land under rice crop was vacated earlier enabling farmers to sow wheat in time. Ultimately the whole system was improved.

INTRODUCTION OF MUNGBEAN IN WHEAT-RICE SYSTEM.

Although the cropping intensity is high enough, still there are certain areas where potential of its increase exists. Introduction of mungbeans in wheat-rice systems is one of the possible alternatives.

About 80 percent of rice crop is sown after wheat. Harvesting of wheat starts from 15th April but transplanting of rice begins after 15th July and continues till 1st week of August in the project area. So the land reserved for rice in wheat-rice system remains vacant for about 2½ months. Short duration mungbean varieties (65 days) can be raised easily without affecting the rice crop.

With this objective, mungbean variety 20-21 was sown after harvesting wheat crop and it matured in about 65 days. The farmers were able to raise an additional crop of mungbean, without affecting the transplanting time of rice crop. This intervention was carried out on farmer's field under their own conditions in 1987-88. The improved system i.e. wheat-mungbeans-rice was compared with farmer practice i.e. wheat-rice. In the improved system, mungbean was sown after harvesting wheat crop while the land remained vacant in farmer's system. The rice crop was transplanted on almost same date in both the systems. Economic analysis of the improved technology, is given in Table 2.

Table 2: INTRODUCTION OF MUNGBEAN IN RICE-WHEAT SYSTEM.

Partial budgeting	Improved Practice	Farmer's Practice
Average grain yield (kg/ha)		
- Wheat	2780	2780
- Mungbean	506	-
- Rice	3652	3752
Field price (Rs/kg)		
- Wheat grain	1.50	1.50
- Bhoosa	0.30	0.30
- Mungbean	8.25	8.25
- Rice grian	2.90	2.90
- Straw	0.20	0.20
Gross field benefit (Rs/ha)	20502.59	16629.00
Variable cost (Rs/ha)	877.19	-
Return above variable cost (Rs/ha)	19625.49	16629.00
Increased benefit (Rs/ha)	2996.49	-
Increased Benefit (%)	18.02	-

The results and economic analysis showed that the farmers were able to increase their average net field benefits by about 18% through improved practice. It was also indicated that the rice yield did not differ significantly and this was due to the fact that rice transplanting was not delayed. Further, the intervention enabled the farmers to raise an additional crop of mungbeans. Mungbean requires very low inputs (Fertilizer and irrigation), improve the fertility of the soil and moreover it fits very well into the existing rice-wheat system.

The most appreciable aspect of mungbean was that it supplemented the available kharif fodder, which is always scarce, in the month of July. Most of the farmers fed this nutritious green matter to their animals after picking the ripened pods.

INTRODUCTION OF TILLAGE TECHNOLOGY.

About 50 percent of wheat is sown after rice. Basmati-Pak and Basmati-370 are popular cultivars. Both are long duration, and matures late. Thus wheat sowing gets delayed. The delay in wheat sowing is considered single most important factor responsible for low wheat yields.

Keeping in view this problem, a low cost technology, zero-tillage, was introduced in the project area. It implies sowing of wheat directly without seed bed preparation after harvesting rice crop using residual moisture.

Wheat crop was sown on different sites after rice crop without seedbed preparation and was compared with farmer's practice, where wheat was sown after seedbed preparation. Under zero tillage, an automatic rabi drill was used, while in farmer's practice wheat was sown by broadcast method. This technology was tested on farmer's fields under their own conditions for three years. All management and agronomic practices were kept same and carried out by the farmers under their conditions. The results are summarized in Table 3.

Three years average results showed that the farmers were able to increase their net field benefits by about 36 percent by sowing with zero tillage method and this was due to the fact that, firstly, the tillage cost was appreciably decreased by about 79 percent and secondly, the grain yield increased by about 19 percent.

The possible reasons contributing to increased yield are, good germination, uniform crop stand, efficient use of fertilizer and water and comparatively early sowing of the crop.

Table 3: ZERO-TILLAGE WHEAT TECHNOLOGY AND ITS COMPARISON WITH FARMER'S PRACTICES.

Particulars	Improved practice	Farmer's practice
Ave. grains yield (kg/ha)	3629	3038
Adjusted grain yield (kg/ha)	3266	2734
Field price (Rs/kg)		
Grains	1.57	1.57
Bhoosa	0.31	0.31
Gross field benefit (Rs/ha)	6140.08	5139.92
Total variable cost (Rs/ha)	155.33	726.60
Return above variable cost (Rs/ha)	5984.75	4413.32
Increased benefit (Rs/ha)	1571.43	-
Increased benefit (%)	35.60	-

RICE STEM BORER IN DIFFERENT TILLAGE SYSTEMS.

It was hypothesized that sowing of wheat by zero tillage method will provide favourable habitat for the survival of rice stem borers and as a result the next rice crop will comparatively be affected more adversely. To test the hypothesis, studies on the survival of rice stem borer in different tillage systems were conducted

Study was conducted for 2 years in 1989-91 in the FSR Shahkot area, Shahkot under four tillage practices in rice-wheat system. The practices included were; rice-fallow (unploughed), rice-fallow (ploughed), rice-sown by conventional method and rice-sown by zero till method. Fifty rice stubbles were collected randomly at 15 days interval during December-February. The stubbles were dissected in the laboratory and the number of infested tillers, live and dead larvae in each sample were counted. The results are given in Table 4.

The data showed that in all treatments the density of larval hibernation was very low i.e. close to zero. As density was below economic threshold (10%) zero tillage can be adopted.

Table 4: SURVIVAL OF RICE STEM BORER LARVAE IN DIFFERENT TILLAGE SYSTEMS IN FSR PROJECT AREA, SHAHKOT.

Tillage system	Number of larvae/100 tillers					
	1989-90		1990-91		Average	
	Live	Dead	Live	Dead	Live	Dead
Rice-fallow (unploughed)	0.53	-	0.04	-	0.28	-
Rice-fallow (ploughed)	0.43	0.14	0.53	0.28	0.48	0.21
Rice-wheat sown by conventional system	0.46	-	0.62	-	0.54	-
Rice-wheat sown by zero-till method.	0.41	-	0.54	-	0.47	-

SESAME (SEASAMUM INDICUM) INTRODUCTION IN SHAHKOT AREA

Wheat occupies an important place in the cropping systems practiced in the project area and has been very well fitted into rice-wheat and fallow-wheat system. About 30 percent wheat is sown in wheat-fallow-wheat system due to shortage of irrigation water and this fallow-wheat system decreased system profitability to a considerable extent. In order to over come this problem a crop of low input requirement, sesame was introduced and fallow-wheat-fallow system was intensified without affecting other related sub-systems.

Economic viability of this intervention is proved by the fact that average wheat yields in both the systems did not differ significantly and the farmers were able to get an extra high value crop of sesame without affecting related sub-systems. Almost equal wheat yields and about 943 kg of sesame per hectare increased farmers net benefits by about Rs. 8720/ha.

Sesame, in addition to grain, also supplemented the existing fuel supply which is much needed in our rural areas. Moreover, it was also observed that sesame cultivation decreased weed population which also contributed to wheat yield.

PARTIAL REPLACEMENT OF WHEAT WITH LENTIL IN SHAHKOT AREA.

Wheat being staple food, the farmers try to bring maximum area under this crop. But they are unable to use optimum inputs, specially fertilizer and irrigation water. As a result, wheat yield is decreased considerably. Partial replacement of wheat with lentil in the existing wheat based system seemed feasible. Lentil crop requires, comparatively very less fertilizer and irrigation. Inputs thus saved, when applied to wheat crop are likely to increase the yield and system profitability.

Twenty five percent area out of the land reserved for wheat crop was sown under lentil. The new system (wheat and lentil) was compared with farmer practice (wheat alone). Out of two acres, one acre was sown under farmer practice i.e. wheat alone and the other acre, was brought under introduced system i.e. 0.75 acre wheat and 0.25 acre lentil. All the management and agronomic practices were carried out under farmer conditions. This technology was developed and adopted within the available resources of the farmer, which was the philosophy of Farming Systems Research. This intervention was carried out on different locations for two years. The results are given in Table 5.

Table 5: A COMPARISON OF CONVENTIONAL AND IMPROVED WHEAT PLANTING SYSTEM.

Particular	Improved practice (wheat+lentil) (0.75 ha+0.25 ha)		Farmer's practice (wheat alone) (1.00/ha)
* Adjusted yield (kg-wheat/0.75 ha & lentil/0.25 ha)			
Grain	3268	277	3413
Bhoosa	3268	277	3413
* Field price (Rs/kg)			
Grain	1.65	8.98	1.65
Bhoosa	0.31	-	0.31
* Gross field benefit (Rs/ha)	6424	2488	6711
* Collective gross field benefit (Rs/ha)	8912	-	6711
* Total var. cost (Rs/ha)	738	-	750
* Ret.above var. cost (Rs/ha)	8174	-	5961
* Increased benefit (Rs/ha)	2214	-	-
* Increase benefit (%)	37.14	-	-

The yield data and economic analysis indicated that, on an average, farmers obtained 3413 kg/ha of wheat grains from their own practice while it was 3268 kg from 0.75 hectare in improved system.

Though, farmer's wheat yield was decreased by about 4.25% on the other hand his net benefits were increased by 37.14 percent. It can, however, be inferred that farmer did no go into loss but his total farm productivity was increased which is the ultimate aim of the grower.

With partial replacement of wheat by lentil the farmer got the following benefits.

* Increased net benefits by about 37%
* Per unit area yield was increased
* Early vacation of land under lentil
* Early cash income and easy marketing
* Early and timely supply of fodder for livestock
* Almost similar variable costs but significantly higher net benefits.
* Lentil is protein rich source of food
* Meeting national goals by increasing production of pulses
* Saving of irrigation water and fertilizer for other crops

CHEMICAL WEED CONTROL IN SHAHKOT AREA (RABI 1987 & 1988).

Weeds, if not controlled, decrease yields upto 50 percent depending upon the degree of infestation. Moreover, hand weeding has become expensive due to shortage of labor and ever increasing wage rates. Further more, it is impossible to hand weed in certain crops which are thickly populated e.g. carrots.

Chemical weed control was introduced in the FSR project area to solve the problem of weeds in carrot, lentil, pea & wheat.

On carrots & pea, stomp-330E was applied at pre-emergence stage @ 3.75 l/ha while Buctril-M and Arelon 75-WP were sprayed on wheat crop after 1st irrigation @ 1.5 litter and 1.80 kg/ha, respectively. These interventions were replicated on different representative locations. The treated plots (0.5 acres) were compared with non-treated entirely under farmer conditions.

The results obtained were statistically analyzed and economic analysis was done by partial budgeting technique to assess the economic viability of the improved technology. The yield data and its analysis is presented in Tables 6, 7 and 8.

Table 6: CHEMICAL WEED CONTROL IN CARROTS.

Particular	Improved practice	Farmer's practice
Average yield (kg/ha)	45034	27583
Adjusted yield (kg/ha)	38279	23445
Field price (Rs/kg)	0.80	0.80
Gross field benefit (Rs/ha)	30623	18754
Total vari. cost (Rs/ha)	720	-
Return above vari.cost (Rs/ha)	29903	18756
Increased benefit (Rs/ha)	11146	-
Increased benefit (%)	59.43	-

Yield data and economic analysis indicated that, on an average, the yield and net benefits increased to 59.43 percent. The results were very encouraging and appreciated by the farmers. It is very difficult to keep carrot crop free of weeds by manual labor as it is thickly seeded. In the untreated fields, weeds like Chenopodium outgrew the actual crop whereas in improved practice, Stomp-330E applied at pre-emergence stage had very effective control of weeds and as a results the shape, girth, length and weight contributed to increased benefits.

Table 7: CHEMICAL WEED CONTROL IN PEA.

Particular	Improved practice	Farmer's practice
Av. yield of green pods(kg/ha)	7463	3805
Adj. yield of green pods(kg/ha)	6343	3234
Field price (Rs/kg)	2.00	2.00
Gross field benefits (Rs/ha)	12686	6468
Total vari. cost (Rs/ha)	720	-
Return above vari.cost(Rs/ha)	11966	6468
Increased benefit (Rs/ha)	5498	-
Increased benefit (%)	85	-

The yield data and economic analysis showed that Stomp-330E had very effective weed control. On an average, the farmer's got Rs. 5498/ha as an increased benefit by spending only Rs. 720 on labor and chemical.

Table 8: CHEMICAL WEED CONTROL IN WHEAT.

Particular	Improved practice	Farmer's practice
Average yield (kg/ha)	4042	3428
Adjusted grain yield (kg/ha)	3638	3085
Field price (Rs/kg)		
Grain	1.55	1.55
Bhoosa	0.30	0.30
Gross field benefits (Rs/ha)	6730	5707
Total vari. cost (Rs/ha)	349	-
Return above vari.cost (Rs/ha)	6381	5707
Increased benefit (Rs/ha)	674	-
Increased benefit (%)	11.81	-

It is clear form the above results that on an average the wheat grain yield was increased by 17.92 percent which contributed to 11.81 percent increase in the net benefits by spending only Rs.349 on labor and chemicals. In 1987-88, the results were not so encouraging because the common weeds were broad leaved which had comparatively less adverse effect on the yield of the crop. Moreover, the soil type was sandy loam.

TESTING OF TECHNOLOGY COMPONENTS.

While interviewing the farmers they mentioned that they are not obtaining good yield of wheat inspite of using nitrogen and phosphorus in light soils. So soil samples were collected, analyzed and it was found deficient in nitrogen and phosphorus with marginal content of zinc. Therefore, following experiments were conducted during 1987-90 under farmer's conditions.

RESPONSE OF WHEAT TO MICRONUTRIENT APPLICATION.

The effect of micronutrient on the yield of wheat crop in wheat-fallow-wheat system was studied. The results are given in Table 9.

The yield data indicated that during 1987-88 K application @ 60 kg/ha significantly increased the grain yield over NP treatment. Similarly application of Zn,Cu and B also significantly increased the grain yield over NPK treatment.

During 1988-89, the differences in wheatyield due to fertilizer treatments were non-significant. However, all the fertilizer treatments gave significantly higher yield than control.

Table 9: AVERAGE WHEAT GRAIN YIELD AS AFFECTED BY THE APPLICATION OF MICRONUTRIENTS.

Treatment	Grain yield (T/Ha) 1987-88	1988-89
Control	0.67f	0.63b
NP (120-100) (kg/ha)	1.88e	2.92a
NPK (120-100-60)"	2.43c	3.06a
NPK + Zn @ 4 kg/ha	3.78a	3.34a
NPK + Cu @ 4 "	2.60b	3.04a
NPK + Fe @ 8 "	2.35c	3.05a
NPK + Mn @ 8 "	2.19c	3.38a
NPK + B @ 4 "	2.64b	3.07a

Actually the farmers were using N:P fertilizers but not in balanced dose. Therefore, the balanced dose of N&P increased the grain yield substantially. Yield was further improved with the use of the micro-nutrients and K application.

COMPARISON OF RELAY VS SEQUENTIAL WHEAT CROPPING SYSTEMS

Late harvesting of cotton sticks adversely affect the wheat yield as wheat sowing gets delayed. Relay cropping technique (broad casting of presoaked seed in irrigated field of standing cotton during middle of November) was introduced to overcome this problem using RCB at 4 to 6 sites. Results are reported in Table 10.

Table 10: A COMPARISON OF WHEAT RELAY CROPPING WITH SEQUENTIAL CROPPING.

Particular	Relay cropping	Sequential cropping
Average grain yield (kg/ha)	3996	3037
Field price (Rs/kg) Grain	1.90	1.90
Bhoosa	0.40	0.40
Gross field benefit (Rs/ha)	9191	6986
Total variable cost (Rs/ha)	21	976
Return above variable cost (Rs/ha)	9170	6010
Increased benefit (Rs/ha)	3160	-
Increased benefit (%)	52.28	-

Relay cropping technology, being very simple, not only saved 98 percent variable cost but also increased wheat yield by 32% and as a result, total net benefit were enhanced by about 53%. The appreciable aspect of this technology was that it did not affect seed cotton yield and its quality.

DIRECT WHEAT SEEDING TECHNOLOGY IN RICE-WHEAT SYSTEM.

Sowing of wheat after rice gets delayed due to tillage operations. Sowing of wheat by broadcasting seed without tilling the land was introduced at six sites. The results are given in Table 11.

Table 11: A COMPARISON OF SURFACE SEEDING OF WHEAT WITH CONVENTIONAL METHOD IN RICE-WHEAT SYSTEM.

Particular		Conventional method	Surface seeding method
Average grain yield (kg/ha)		3492	4971
Field price (Rs/kg)	Grain	2.60	2.60
	Bhoosa	0.40	0.40
Gross field benefit (Rs/ha)		10478	14914
Total variable cost (Rs/ha)		976	30
Return above variable cost (Rs/ha)		9502	14884
Increased benefit (Rs/ha)		-	5382
Increased benefit (%)		-	56.62

The surface seeding of wheat which facilitates timely sowing of wheat after rice, resulted in 42% increase in yield over conventional sowing. Moreover the variable cast of surface seeding was 97% less than normal method and thus it gave 57% higher benefits.

COMPARISON OF DIRECT SEEDED VS TRANSPLANTED RICE.

To increase plant density in rice crop, direct seeding technology was introduced. The results of farm level trials are presented in Table 12.

It was observed from the yield and economic analysis that farmer's paddy yield was increased by 19 percent and total variable costs were decreased by 61%. As a result net income enhanced by 30 percent.

Table 12: A COMPARISON OF DIRECT SEEDING AND TRANSPLANTING OF RICE.

Particular	Direct seeded rice	Trans-planted rice	Increase/ decrease (%)
Average grain yield (kg/ha)	6265	5247	+ 19.41
Field price (Rs/kg)	3.88	3.88	
Gross field benefit (Rs/ha)	24309.71	20357.89	
Return above variable cost (Rs/ha).	939.50	2437.50	- 61.47
Increased benefit (Rs/ha)	5452.21	-	
Increased benefit (%)	30.43	-	

The reason in support of such appreciable results attributed to be adequate plant population and saving in labor expenses, which on the other hand might have caused a significant decrease in yield and net benefits of rice crop grown through conventional practices.

EFFECT OF FEEDING UREA TREATED STRAW ON MILK PRODUCTION.

The study aimed to examine the effect of feeding urea-treated wheat straw on the milk production and milk composition. The animals in the control group were fed on untreated wheat straw plus green fodder and concentrate to meet their maintenance and production requirements. Treated-wheat straw, plus green fodder substituted as feed requirements in cows of the experimental group. The average daily milk yield of the animals fed on untreated and urea-treated wheat straw was 5.5 and 6.4 litters/day, respectively. The cows fed on treated straw exhibited significantly higher intake and lower green fodder consumption (Table 13). While no significant differences were noted in either milk yield or composition. The study showed that treated straw may partially substitute for green fodder when pasture is scarce. About 250 farmers in the area have adopted the enrichment of wheat straw with urea.

Table 13: AVERAGE DAILY FEED INTAKE, AND MILK YIELD OF COWS FED ON DIFFERENT REGIMES.

Particular	Un-treated	Urea-treated
Av. daily feed intake (Kg)		
a) Wheat straw	3.42	6.65**
b) Green fodder	24.11	18.05**
c) Concentrate	2.28	2.38 NS
Av. daily milk yield (Kg)	5.55	6.39 NS

IMPROVED FODDER

Improved fodder varieties were introduced among the farmers of FSR target area, Shahkot. Preliminary results showed that S. S. Hybrid and MOTT grass are the most promising cultivars for more green bio-mass production. S. S. Hybrid was compared

with sorghum/maize in wheat-sorghum/maize-wheat system. Green fodder yield and cost of production are given in Table 14.

The extra green fodder produced by S.S Hybrid over the sorghum/maize, together with less variable costs gave participant farmers a double fodder intervention pay off. The S. S. Hybrid not only produced quality fodder as compared with the sorghum-maize system but new intervention also reduced the cost of fodder production by 42%.

Table 14: PERFORMANCE OF SORGHUM 'SADABAHAR' AS A MULTICUT FODDER.

Particular	Improved practice	Farmer practice
	Sadabahar	Maize/sorghum
Sowing time	March	March & May
Yield (T/ha)	138.98	74.20
Adjusted yield (T/ha)	126.00	66.00
Variable cost (Rs/ha)	2940.00	2706.00
Cost of production (Rs/T)	23.27	40.47

INTRODUCTION OF MOTT/GROSS.

For continuous green fodder production on small strips/banks of water channels etc. a perennial multi-cut fodder was introduced. The fodder gave excellent results when tested at the University Research Station, Faisalabad. If managed properly it persists for many years. It has excellent drought tolerance ability. The forage quality is excellent which is even maintained by harvesting at different stages of growth. The establishment through vegetative propagation is very easy under most of the irrigated tracts in the country. Production performance of MOTT is better than all other Kharif fodders (Table 15). The palatability is excellent and ruminants like this fodder. Mott grass cultivation by the farmers has spread like fire. Due to multi-cut and very

high bio-mass production characteristic, MOTT grass has been adopted not only by farmers of the neighboring areas but farmer from other provinces and even from AJK have taken rootstock for cultivation. So for about 2500 farms from different areas have obtained the root stock either from University of Agriculture, Faisalabad or from National Agricultural Research Centre, Islamabad.

Table 15: YIELD OF MOTT GRASS FODDER.

Particular	T/ha
Cutting at 4.5 ft. height	48.00
Cutting over 5.5 ft. height	76.00
Crude protein (%)	10.71
Dry matter digestibility (%)	63.00
Cutting interval (days)	40-45
Number of cuttings/year	4-6

SILAGE MAKING AND FEEDING

Silage preparation at farm level has been successfully accomplished using green materials (sorghum, maize , sugarcane tops). The seasonal surplus fodder can effectively be converted into silage for use during scarcity period.

The average daily milk yield of the animals was 9.39 kg on silage feeding, whereas with routine fodder, it was 9.28 kg Table 16. The feed intake values on dry matter basis for silage feeding and routine fodder were 8.47 and 8.86 kg, respectively. The analysis of variance revealed a non-significant differences in milk production, milk protein, SNF, total solids and ash. Significant differences ($P<0.01$) in feed intake were observed. The results suggested that silage feeding can be practiced as a source of green roughage to greater extent during the periods of green fodder scarcity for dairy animals.

Table 16: AVERAGE MILK PRODUCTION AND FEED CONSUMPTION OF ANIMALS FED ON DIFFERENT REGIMES.

Particular	Green fodder	Sorghum silage
Daily milk yield (Kg)	9.28	9.39 NS
FEED CONSUMPTION		
Silage (Kg/day)	-	8.47
Green fodder (Kg/day)	8.86	-
Concentrate (Kg/day)	2.98	2.99 NS
Cost of milk production (Rs/kg)	1.30	1.25
Cost benefit ratio	1:2.30	1:2.39

ECONOMIC BENEFITS OF DEWORMING IN SHEEP

Deworming experiments were conducted to demonstrate and test the effect on growth performance of sheep at several sites in Shahkot and Proka project areas. Drenching cost per animal was Rs. 4.0 and weight gain data indicated 63.16 and 39.58 g per animal per day for the treated and control groups, respectively. Gross benefits and net benefits per animal during trial period were Rs. 65.09 and Rs. 61.09, respectively (Table 17).

Table 17: ECONOMIC BENEFITS OF DEWORMING IN SHEEP FOR 120 DAYS.

Particular	Dewormed group	Control group
Drenching cost (Rs/head)	4.00	-
Daily weight gain/head (Gm)	63.16	39.75
Av. weight gain/head (Kg)	7.58	4.75
Av. additional gain (Kg)	2.83	-
Gross benefit (Rs/animal)	65.09	-
Net benefit (Rs/animal)	61.09	-
Cost benefit ratio	1;15.27	-

SINDH AGRICULTURE UNIVERSITY, TANDOJAM

AGRONOMIC INTERVENTIONS IN WHEAT AT HALA SITE.

Wheat-cotton is a predominant cropping system at Hala site. During Rabi 1987-88, wheat was planted with four cooperating farmers under improved practices and compared against farmer's practices. The interventions were based on farmer's circumstances whereby wheat production constraints were identified as seed mixture, diversity in selection of varieties by the farmers and lessor fertilizer use.

-	Improved practices :	Variety	:	Sarsabz
		N	:	147 kg/ha
		P2 05	:	85 kg/ha
-	Farmer's practices :	Variety	:	Farmers
		N	:	80 kg/ha
		P2 05	:	57 kg/ha

It was noted that with improved practices wheat growers of the area could harvest 57.2 and 80.9% higher yields of wheat grain and straw, respectively. It may be concluded that cultivation of pure seed of improved wheat variety (Sarsabz) with recommended doze of fertilizer, on an average, gave additional net return of Rs. 3238.13/ha and growers were able to avail cost benefit ratio of 1:3.49 in Hala area during 1987-88.

AGRONOMIC INTERVENTIONS IN WHEAT AT TANDO MUHAMMAD KHAN SITE.

At Tando Muhammad Khan site, rice-sugarcane-wheat constitutes a major cropping system. Results of formal survey showed that 26% of the farmers followed sugarcane-rice-wheat and 6% practiced sugarcane-wheat-sugarcane rotation. Wheat production constraints were identified as seed mixture, low priority to variety consideration and lessor use of fertilizer. The interventions were formulated on the basis of above constraints. Wheat was planted with three cooperating farmers under improved practices and compared against farmer's practices. The interventions were the same as those used at Hala.

The results indicated that wheat crop sown with improved practices in rice-sugarcane-wheat system, on an average, gave an increased productivity of 889 kg/ha of grain and 803 kg/ha of straw over the farmer's practice. These increases were 29.4 and 22.5% of farmer's yield, respectively. The economic analysis indicates that through improved practices Rs. 1140.72/ha can be pocketed as an additional income.

It was found out that cultivation of wheat under improved practices viz; pure seed and recommended doze of fertilizer can be more beneficial than the farmer's practices as it gave cost benefit ratio of 1:2.28 in Tando Muhammad Khan area during 1987-88.

Farmers in Tando Muhammad Khan area do not cultivate barley in Rabi season. However, barley stands a good alternative crop to wheat under salt affected areas. Therefore barley was grown adjacent to wheat in one of the three wheat trials. It yielded 3600 kg/ha of grain and 4230 kg/ha of straw.

WATER MANAGEMENT/AGRONOMIC INTERVENTIONS IN WHEAT AT HALA SITE.

Survey of the area indicated yield constraints resulting from improperly levelled land, seed mixture, under fertilization and inadequate water management practices. Therefore, wheat trials were laid out to study the relative system performance with and without land levelling under improved agronomic interventions and farmer's practice.

Wheat was planted with four farmers under improved practices viz; land levelling, pure seed of Cv. Pavan; irrigation scheduling and 147-85 kg N:P/ha and compared with the farmer's practices viz; farmer's practice of land levelling, farmer's seed and 80-57 kg N:P/ha.

Improved practice (IP) gave additional 1350 kg/ha of grain and 1730 kg/ha of straw, over the farmer's practice (FP). On percentage basis, IP yielded 47.7% and 64%

more grain and straw, respectively compared to FP. The contribution of various factors were determined to be 43% by levelling and 14% by irrigation scheduling.

It was found that wheat variety Pavan when grown under improved practices yielded an additional net income of Rs. 2005.00/ha in Hala area. The cultivation of wheat variety Pavan under improved water and soil management practices was beneficial as it gave C:B. ratio of 1: 2.65.

INTRODUCTION OF IMPROVED MUNGBEAN VARIETY.

Mungbean (Vigna radiata (l.) Wilozek) is a major pulse crop grown at Hala site, during spring season predominantly under onion-mungbean cropping system. The results of diagnostic survey showed that average yield of mungbean was 390 kg/ha. Low yields were attributed to cultivation of local cultivars with low inputs. Moreover, traditional mungbean types would take around 90 days to mature whereas improved types require 60-70 days to mature. With early maturing crop, the produce can fetch higher prices in the market.

The scientists of the Atomic Energy Agricultural Research Centre, Tandojam have been working on the performance of various mungbean types. In order to introduce and test the performance of promising mungbean variety 20-21 on farmer's field, five trials were conducted on one acre plots under onion-mungbean system. Improved mungbean variety 20-21 was compared with local cultivar with and without application of DAP and Rhizobium inoculum.

The results indicated that improved variety with improved practice yielded 65.8% higher productivity as against farmer's practice. However, farmers obtained higher yield of straw by cultivating local cultivar as against improved variety 20-21. The increase in straw yield was 322 kg/ha (3484 & 3162 kg/ha, respectively). Economic analysis reveals that improved variety when grown with the application of DAP and inoculum, yielded additional net income of Rs. 3451.03/ha in Hala area. The cost

benefit ratio was 1:3.52.

INTRODUCTION OF SOYBEAN AT HALA SITE.

Soybean (Glycine max) can be grown as spring and summer crop. Its importance in national economy need not be emphasized. Current cropping patterns followed by the farmers at FSR target areas do not include this important crop. However, it can be introduced only if it has relevance to farming system prevalent in target areas. As a result of farm survey, constraint identification and determination of opportunities for introduction of new crop, it was hypothesized that soybean can be grown as alternate crop in place of mungbean under onion-mungbean system.

In order to test the biological and economic feasibility of soybean as compared to mungbean, four trials were conducted alongside the mungbean trials at Hala site during spring 1988. Soybean cv. Steele was planted with four farmers with and without inoculum (I) and fertilizer (F) at the rate of 30-75-0 kg N:P:K/ha.

The data showed that soybean yield increased by 1019 kg/ha under the combined effect of inoculum and fertilizer. The contribution of inoculum and fertilizer in yield increase was 17.7 and 82.3% respectively.

Economic analysis of soybean vs mungbean showed that farmer can obtain additional net income of Rs.1404.00/ha by growing soybean compared to mungbean (under farmer's practice). However, input-output ratio was somewhat better (1: 3.76) under mungbean as compared to soybean (1: 3.31). When comparison of soybean was made with that of improved mungbean (20-21) under IP, input-output ratio was 1: 3.31 for soybean as against 1: 4.39 for mungbean.

INTRODUCTION OF PURE SEED OF COTTON VARIETY (NIAB-78).

Introduction of pure seed of improved cotton variety (NIAB-78) performed well in the target area Hala. The increased yield of cotton over farmers practice recorded was 2484 kg/ha. The increase was 64.73% over farmer's own practice. This intervention has proved very much beneficial in the target area Hala. Collaborating and neighboring farmers have adopted this practice for increasing their productivity.

In other trial comparison of improved variety and improved plant density with farmer variety and plant density was carried out. The results are given in Table 18.

Table 18: YIELD OF COTTON (KG/HA) OBTAINED THROUGH IMPROVED PRACTICES AT HALA SITE DURING 1991-92.

Locations	PS + RD	PS + FD	FS + RD	FS + FD
I.	1287	1100	1131	1017
II.	1451	1157	1201	1091
III.	1118	1000	1009	990
IV.	1375	1098	1127	1025
V.	1289	1100	1116	1076
VI.	1348	1150	1240	1029
Average	1311	1100	1137	1038

PS = Pure seed of cotton CV. NIAB-78
RD = Recommended density (30 x 60 cm)
FS = Farmers seed (Purchased from market)
FD = Farmers density (less Nos of plants)

It was noted that pure seed of cotton cv. NIAB-78 produced 15.30% more yield as compared to farmers own seed. Farmer can earn Rs. 1280.64 more per ha. It is also clear from the result that recommended planting density gave 19.18% more yield as compared to farmers planting density. Farmers can earn Rs.1419.84/ha as an additional income by adopting recommended planting density.

PERFORMANCE OF WHEAT PLANTED THROUGH MINIMUM TILLAGE IN FSR AREA HALA, DURING 1991-92.

Onion is one of the important crop grown in Hala area. Onions are planted by two different methods. Farmers plant onion by onion bulbs in August and September. They harvest the crop in the end of November and December. Delay in harvesting of onion resulted in leaving the land fallow. On availability of minimum tillage it was decided to plant wheat in the fields vacated from onion. This way farmers will get an extra crop of wheat and residual fertilizer in the onion fields will be utilized by wheat crop. This practice proved very beneficial in onion-fallow-onion system. Thus this practice was continued during the year 1991-92 to popularize it among the farmers. The results are given in Table 19.

Table 19: GRAIN AND STRAW YIELD (KG/HA) OF WHEAT OBTAINED UNDER MINIMUM TILLAGE PRACTICE IN HALA DURING 1991-92.

Location	Grain	Straw
1.	3425	3525
2.	3232	3250
3.	3675	3750
4.	3320	3400
Average	3413	3481

The result indicated that planting of wheat in onion-fallow-onion system with minimum tillage drill produced 3413 kg grain and 3481 kg of straw per ha.

It may be concluded that cultivation of wheat with zero tillage drill in onion-fallow-onion system, on an average yielded additional net return of Rs. 10473/ha and growers were able to obtain cost benefit ratio in Hala area.

AGRONOMIC INTERVENTIONS IN MUNGBEAN AT HALA DURING 1992.

In FSR area Hala farmers grow mungbean on lands vacated after onion harvesting. The yield level was low. The major constraints identified was impure seed of long maturity period. During the pervious year's results it was noted that introduction of pure seed of improved variety proved superior compared to farmers practice. The mungbean mutant produced not only highest yield but confirmed its earliness and uniform maturity behavior. It was therefore decided to continue the introduction of pure seed of AEM/620 with application of increased level of phosphorous fertilizer. The result achieved are presented in Table 20.

Table 20: EFFECT OF VARIETY AND N:P FERTILIZER ON YIELD OF MUNGBEAN (KG/HA)

Intervention	Grain Yield	Intervention	Grain Yield	Fertilizer Average.
F1	1585	F4	1312	1448
F2	1875	F5	1562	1718
F3	2227	F6	1832	2029
Variety Av.	1895		1568	

F1 = Improved seed + 22.5-57.5 kg N:P/ha
F2 = Improved seed + 33.7-86.3 "
F3 = Improved seed + 45-115 "
F4 = Farmers seed + 22.5-57.5 "
F5 = Farmers seed + 33.7-86.3 "
F6 = Farmers seed + 45-115 "

The results indicated that introduction of pure seed of mungbean produced 327 kg/ha more grain yield over farmer's own seed. By planting improved seed of mungbean farmers can earn Rs. 3270.00/ha as an additional income.

When the level of fertilizer was increased from 33.7-68.3 to 45-115 kg N:P/ha, the grain yield of mungbean was increased up to 311 kg per ha. The net return obtained

through application of 45-155 N:P was Rs.3110.00 per ha. The cost benefit ratio achieved was 1:4.41 which is remunerative.

TANDO MUHAMMAD KHAN SITE.

Introduction of pure seed of high yielding wheat varieties with recommended level of N:P fertilizers has resulted in increase in grain and straw yield up to the extent of 56% as compared to farmer's own practice. Cost-benefit ratio earned was 1:3.2. The intervention of pure seed and application of recommended level of fertilizer have been widely adopted by the collaborating as well as neighboring farmers due to increase in the productivity through these interventions.

Introduction of pure seed of rice also resulted in increase in grain yield up to the extent of 60% as compared to farmer's yield under his own practice. The cost-benefit ratio was 1:2.9 with pure seed and recommended level of N:P fertilizer. The farmers of the area have realized and are fully aware about the effect of pure seed and fertilizer application in boosting up the farm productivity.

Introduction of increased plant population (overlapping method) in sugarcane with recommended application of N:P:K fertilizers introduced in the area which have resulted in increased yields to the extent of 70-80% as compared to farmer's yield. This practice has been widely adopted by the collaborating and neighboring farmers on larger scale due to increase in the productivity.

Intervention of inter-cropping of onion in sugarcane has been very much appreciated by the farmers as it yielded an additional income of Rs. 9940.50/ha. The cost-benefit ratio earned was 1:2.38. This intervention has widely been adopted by the collaborating and neighboring farmers.

Intervention of improved feeding and management practices increased the milk production in buffaloes by feeding economical ration and through enhanced fodder

supply through multi-cut Mott grass.

PILOT TO PRODUCTION PHASE 1992-94.

Keeping in view the success of pure seed of high yielding varieties of wheat, cotton, rice and mungbean and application of recommended level of N:P fertilizer, these interventions were incorporated in production phase for popularizing and producing the seed on large scale in the area. Intercropping of onion in sugarcane and multiplication of Mott grass fodder were also incorporated in production phase as these have already proved successful in testing phase.

Since the interventions have proved successful at farmer's field, the shifting of these interventions to pilot to production phase has changed the socio-economic conditions and has played a vital role in the prosperity of farming community. For production and multiplication of pure seed of wheat, varieties Mehran-89 and Sarsabz were planted on larger scale. The average yield obtained was 3800 and 3500 kg/ha from Mehran-89 and Sarsabz, respectively. The total seed of 30, 400 and 12600 kg of Mehran-89 and Sarsabz was obtained. The interested farmers were identified for seed production and storing the seed for selling in the next season. These seeds were sold in the next season for plantation in the area. This has helped in over coming the shortage of pure seed of improved variety and also benefitted the neighboring farmers as they can purchase the quality seed on their door steps.

Similarly the intervention of inter cropping of onion in sugarcane on large scale was also carried out. It was found that farmers can get additional yield of 11350 kg of onion from one hectare in five months period. This practice has been widely adopted in the sugarcane growing area and farmers are getting additional income from this crop.

Multiplication and production of pure seed of mungbean were also carried out in Hala area during 1992-94. The pure seed of improved mungbean was planted with

20 farmers in different villages. The average yield recorded was 1595 kg/ha. The interested farmers for storing of this seed were identified and trained in storage of seed. This seed was sold to the neighboring farmers for plantation in their fields.

Introduction and multiplication of MOTT fodder was also carried out on large scale for minimizing the fodder shortage in the area. This fodder was planted in Districts Hyderabad, Mirpur Khas, Umer Kot, Sangher, Thatta, Badin and Karachi with 1500 farmers. Some of the NGO's also collected the cuttings of this fodder for further multiplication at different places. Many farmers have reported that milk production was increased due to feeding this fodder.

Intervention of large scale multiplication and production of pure seed of rice was also carried out in Tando Muhammad Khan area. Rice was planted on large area in eight different villages. The average yield recorded was 6200 kg/ha. Some of the interested farmers were selected in these villages for storing the pure seed for next season plantation. This helped the farmers in getting the pure seed of rice from the neighboring villages. Rice productivity of the neighboring farmers was also increased.

AGRICULTURAL RESEARCH STATION, DHODIAL, MANSEHRA

INTRODUCTION OF IMPROVED MAIZE VARIETY AZAM.

Five target areas were selected in Distt. Mansehra to carry out FSR activities on maize. At all sites farmers variety Hazara double was compared with improved variety "Azam" for enhancing maize production. The results are given in Table 21.

It is evident from the results that maize yield with farmers technology was 4.66 T/ha grain and 9.54 T/ha stover as compared to 6.17 and 10.58 T/ha grain and stover, respectively, with improved technology. Statistical analysis revealed that, the increases in grain as well as stover yield due to the introduction of improved technology over farmer's technology were significant. Economic analysis supported the results by

achieving 235% MRR by improved technology over farmer's technology.

Table 21: AVERAGE MAIZE GRAIN AND STOVER YIELD (T/HA) WITH FARMER'S AND IMPROVED TECHNOLOGY.

Component	FT	IT	LSI	SE
Grain yield	4.66	6.17	6.42**	0.234
Stover yield	9.54	10.58	3.01*	0.346

FT = Variety Hazara double, seed rate 60 kg/ha and 57 kg N/ha.
IT = Variety Azam, seed rate 40 kg/ha and 136-57 kg N:P/ha.

HAND WEEDING VS CHEMICAL WEED CONTROL IN MAIZE

Delayed planting of maize which starts after the onset of moon soon rains in Hazara Division, generally faces severe competition from weeds. Hand weeding is a common practice for weed control in maize. But due to scarcity of manual labor, most of the crop is heavily infested with a variety of broad and narrow leafed weeds. These weeds compete for nutrients as well as moisture, and also provide inhabitation for insect pests. This heavy weed competition results in poor yields, generally far below average or even complete failure of the crop. A selective herbicide, "Primextra" was sprayed before the emergence @ 4 liters/ha, to compare hand weeding with chemical control of weeds. Results of weed control intervention are summarized in Table 22. Hand weeding on the average produced 3.60 T/ha grain and 7.31 T/ha stover yield. Whereas, the application of Primextra yielded 4.83 and 9.50 T/ha of grain and stover, respectively. Statistical analysis revealed significant increases in grain as well as stover yields by chemical method of weed control over hand weeding.

Table 22: EFFECT OF HAND WEEDING AND CHEMICAL WEED CONTROL ON MAIZE GRAIN AND STOVER YIELD (T/HA).

Component	FT	IT	LSI	SE
Grain yield	3.60	4.83	6.07**	0.203
Stover yield	7.31	9.50	8.62**	0.255

** = Significant difference at (P = 0.1).

Similarly, the economic analysis shows that application of Primextra for weed control in maize was very effective and economical than hand weeding. The marginal rate of return achieved by applying Primextra against hand weeding was 356% (Table 23).

Table 23: ECONOMIC ANALYSIS OF HAND WEEDING VS CHEMICAL WEED CONTROL IN MAIZE.

Treatment	Gross benefit (Rs/ha)	Variable cost (Rs/ha)	Benefit (Rs/ha)	MRR (%)
Hand weeding	12610	880	11730	-
Preimextra	15802	1580	14222	356

COMPLEMENTING POLLEN SOURCE IN UNFRUITFUL APPLE ORCHARDS.

Unfruitfulness is a common problem in apple orchards in Mansehra Distt. where monocultured varieties are grown. To overcome this problem different pollinator varieties viz; Melontash, Harri, Nugget, King Delicious and Red Delicious were tested at four different locations for their compatibility. The results indicate that varieties Melontash and Nugget proved to be the best pollinator, giving an average number of 134 and 132 fruits/plant, respectively (Table 24).

Table 24: EFFECT OF DIFFERENT POLLINATING VARIETIES ON APPLE FRUIT SETTING (NUMBER OF FRUITS/PLANT).

Location	Pollinating variety				
	Melontash	Harri	Nugget	K.Del.	R.Del.
Chotial	40	25	-	30	-
Ahal	250	-	150	200	-
Qazi Abad	50	-	105	150	30
Battal	195	-	140	60	-
Average	134	25	132	110	30

INTRODUCTION OF PEAS IN MONOCROPPED AREA.

In Chattar Plain monocropping pattern "Rice-fallow-rice" and "maize-fallow-maize" was followed. In order to increase the cropping intensity in the area, peas (cv. Green sword) were sown after rice and maize crops with six farmers. Planting at all the locations was completed during the first week of November 1991. Picking of peas completed in the last week of May, well before the time of maize planting i.e. first week of June. A maximum yield of 2900 kg/ha was obtained when peas were sown after maize, whereas yield of peas after rice was 380 kg/ha. The yield ranged from 180 to 2900 kg/ha. The causes of low yields with some farmers were moisture stress at planting time, and occurrence of hail storm during flowering. These results, however, proved that peas can be cultivated in this mono crop system.

CONTROL OF ACTO/ENDO PARASITES AND EFFECT ON PRODUCTIVE PERFORMANCE OF SHEEP AND GOATS.

A total of 300 each of sheep and goats belonging to three farmers were selected in Siren Valley of Mansehra District. Keeping 50% animals as control, half the animals in each category were subjected to treatment. Treatment consisting of drenching on

quarterly basis for round worms and flukes and spray/dipping for control of ticks. Necessary vaccination to save the animals from fatal diseases were provided to both the treated and control groups. Casual treatment was also provided. The results are presented in Table 25.

Table 25: EFFECT OF PARASITIC CONTROL ON THE PRODUCTIVE PERFORMANCE OF SHEEP AND GOATS.

Parameter	Treated		Control	
	Sheep	Goats	Sheep	Goats
No. of animals	150	150	150	150
Mortality (%)	4	6	13	15
Weight gain (g/h/d)	22 (29)	24 (60)	17	15
Wool/hair (g/h)	980 (42)	520 (43)	690	364
Lambing/kidding (%)	103	118	101	106
Sale price (Rs/ha)	510	600	450	500
Progeny value 120 days				
Weight gain (g/h/d)	154 (17)	150 (9)	132	137.5
Wool/hair (g/h)	280 (33)	-	210	-
Sale price (Rs/h)	370	360	317	307

- (Figure in parenthesis indicates percent increase in treated flock over control)
- (Weight gains in pregnant animals are not included).

Mortality was much decreased in treated groups of sheep and goats (4% and 6%) as compared to control (13% and 15%), respectively. Over 29.4% increase in sheep and 60% in goats was achieved in daily weight gain of treated animals. Marked increase in wool production (42%) in treated sheep was recorded and 42.8% increase in hair was recorded in goats. Marginal rate of return for sheep and goats was 548 and 646%, respectively.

INTRODUCTION OF IMPROVED FODDER.

Shortage of green fodder was recognized as major constraint in animal nutrition. Two acute shortage periods are observed viz winter (Dec-Feb) and summer (June-July). It was observed that farmers had a common practice to feed wheat crop to their animals. Keeping in view this constraint, multicut oats crop was introduced among the farmers during rabi 1991 in order to replace the traditional wheat crop. The results are shown in Table 26.

Table 26: PRODUCTION PERFORMANCE AND ECONOMIC ANALYSIS OF OATS AND WHEAT AS FODDER

Particular	Wheat	Oats
Fodder yield (Kg/ha)	23500	105500
Gross benefit (Rs/ha)	6000	26936
Total variable cost (Rs/ha)	3013	6786
Net benefit (Rs/ha)	2983	20150
Marginal rate of return (%)	-	457

Comparative study revealed high production of oats as compared to wheat. Early supply of fodder from oats (February) as compared to wheat (April) is also an additional benefit to the farmers. Three cuttings obtained from oats with a total produce of 23.5 ton/ha.

INTRODUCTION OF IMPROVED POULTRY BREED AMONG FARMERS.

Poultry plays a pivotal role in peasant life as a source of protein, as well as income source. Non discript, low producing desi breed was recognized as most important constraint. It was realized that egg production can be increased through introduction of better quality breed and improving feeding practices.

Keeping in view the above mentioned recommendation, Fumi birds were distributed among 27 families of three villages. One unit (4 females + 1 male) was allotted to each family. Feed concentrates as well as necessary vaccination was also provided. Comparative performance of fumi birds was analyzed against the performance of local breed. Data collected on the productive performance of Fumi versus desi is given in Table 27.

Table 27: PRODUCTIVE PERFORMANCE AND ECONOMIC ANALYSIS OF 'DESI' VS FUMI BREED OF POULTRY.

	Desi		Fumi	
Particular	Qty	Rs	Qty	Rs
Number of birds.	4	-	4	-
Eggs (dozen/year)	16	192	56	672
Meat (kg)	10	200	7.5	150
Input	-	255	-	370
Return	-	137	-	452
			MRR =	276%

Egg @ Rs. 12.doz
Meat @ Rs. 20/kg

AGRICULTURAL RESEARCH INSTITUTE, SARIAB, QUETTA

The FSR activities in Baluchistan started in 1988-89. The scientists from Agriculture Research Institute, Agriculture Extension, Forest and Livestock departments and Arid Zone Research Institute, collaborated in the FSR activities. A brief account of achievements obtained in Baluchistan is illustrated as under.

INCREASING YIELD POTENTIAL OF ONION

This intervention was carried out during kharif, 1991 on farmer's fields in FSR target area Kanak valley at six locations. The objective of this study was to compare the performance of onion crop under farmers and improved package of technology. The sowing was done in March, 1991 by broadcasting the seed on well prepared soil. The high yielding variety of Chiltan-90 and recommended dose of fertilizer 73-69-48-52 kg NPKS/ha was compared with local strain of onion and a fertilizer dose of 64-46 kg N:P/ha. The results are given in Table 28.

The results depicted a significant increase in onion yield as a results of improved/high yielding variety and recommended dose of fertilizer over farmer's variety and farmer's dose of fertilizer. As a result of this intervention onion yield was increased by about 53% over farmer's technology.

It was observed from economic analysis that with the introduction of this intervention/package of improved technology farmer's net income was increased by more than Rs. 11,000/ha. Ultimately it contributed to higher net farm income and the whole system was improved.

Table 28: AVERAGE YIELD AND ECONOMIC RETURN FROM ONION UNDER IMPROVED AND FARMER'S PRACTICE AT SIX LOCATIONS.

Particular	Improved Practice	Farmer's Practice
Average yield (kg/ha)	2100	1370
Gross income (Rs/ha)	42000	27400
Cost of production (Rs/ha)	8636	5664
Net income (Rs/ha)	33364	21736
Added cost (Rs/ha)	2772	-
Increase in income over FP (Rs/ha)	11628	-
Marginal cost benefit ratio	1:4.19	-

IMPROVING FODDER PRODUCTION.

Fodder scarcity due to use of low green fodder yielding cultivars of lucern is well recognized and is one of the most important factor responsible for poor health of animals in the target area. Keeping this in view the high yielding lucern variety 8/9 was tried to provide more green fodder to ruminants and the surplus could be converted into hay for use during the deficit period.

Two lucern varieties 8/9 and local were planted during October, 1990 at four locations in target area. The sowing was done by broadcasting in well prepared soil. A fertilizer dose of 18-46-00 kg NPK/ha was applied at sowing time. The green fodder yield and variable costs were recorded. The economic analysis was done which is presented in Table 29.

Table 29: GREEN FODDER YIELD AND ECONOMIC RETURN FROM IMPROVED AND FARMER'S VARIETY/PRACTICES OF LUCERN AT VARIOUS LOCATIONS IN KANAK VALLEY 1991-92.

Particular		Improved Variety	Farmer's Variety
Yield (T/ha)	Site 1	94.50	55.25
" " "	Site 2	85.75	49.75
" " "	Site 3	86.50	52.00
" " "	Site 4	89.25	55.00
Average		89.00	53.00
Gross income (Rs/ha)		33375	19875
Cost of production (Rs/ha)		4539	2902
Net income (Rs/ha)		28836	16973
Added cost (Rs/ha)		1673	-
Increase in income over FP (Rs/ha)		11863	-
Marginal cost benefit ratio		1:7.25	1:6.85

* Price Rs. 15.00/40 kg.

The yield data indicated that improved variety 8/9 has produced significantly higher green fodder yield as compared to farmer's variety under farmer's condition. As a result of introduction of high yielding Lucern variety the fodder yield was increased by 68%.

With this intervention the overall fodder production of target area was improved and the net benefit of the farmer's was increased by 70%.

IMPROVING WHEAT PRODUCTION

The objective was to increase the productivity of wheat through introduction of high yielding wheat variety and package of production technology.

The sowing was done in the month of November, 1991 at seven locations in the target area. The performance of improved wheat variety Pak-81 with recommended dose of fertilizer i.e. 396-69-28-52 kg NPKS/ha was compared with local wheat variety and farmer's fertilizer dose of 55-23 kg NP/ha. The results are summarized in Table 30.

The data revealed that improved wheat variety pak-81 and use of recommended rate of fertilizer have produced significantly 142% more grain yield as compared to farmer's variety and dose of fertilizer. The economic analysis indicates that the introduction of improved wheat variety and use of balanced dose of fertilizer enhanced net income by Rs. 7666.00/ha. Ultimately it contributed to highest net farm income and the whole system was improved.

Table 30: WHEAT YIELD AND ECONOMIC RETURN RECORDED UNDER IMPROVED AND FARMER'S PACKAGE OF TECHNOLOGY AT KANAK VALLEY 1991-92 (AVERAGE OF SEVEN LOCATIONS.

Particular	Improved Practices	Farmer's Practices
Average grain yield (kg/ha)	4,670	1,930
Average straw yield (kg/ha)	5,610	3,570
Cost of production (Rs/ha)	3,735	2,061
Income from grain (Rs/ha)*	14,010	5,790
Income from straw (Rs/ha)*	2,805	1,685
Gross income (Rs/ha)	16,815	7,475
Net benefit (Rs/ha)	13,080	5,414
Added cost (Rs/ha)	1,674	-
Added out put (Rs/ha)	7,666	-
Marginal cost benefit ratio	1:4.58	-

* Grain @ of Rs. 3.00/kg
* Straw @ of Rs. 20.00 /40 kg

MANAGEMENT OF INSECT PESTS IN APPLE ORCHARDS.

This intervention was carried out during Kharif 1992 on farmer's fields in FSR target area, Kanak valley at three locations. The objective of this study was to monitor the proper time of spraying against two generations of codling moth. Two pheromone traps were installed at distance of 2 kilometer in the selected orchards.

The peaks moth catches of Ist generation were observed on April 30, 1992 in the both traps. The first spray was started from first May, 1992, with Gosathion 20 EC 150 CC/100 liters of water.

A miticidal spray was applied with Neurone 20 EC @ 100 ml/100 liters of water against mites when 5-10 mites were observed per leaf in the third week of June. For the second generation of codling moth same pheromone traps were installed in first week of June with fresh capsules, for monitoring of second generation of codling moth. The peak of moths was observed on June 27th in both traps. Number of moth catch in Bio and 200 con tap were 15 and 28, respectively. Spray against 2nd generation was done on first July and the cover spray was applied on 12 July 1992 with Denital 10 EC @ 60 ml/100 liters of water. The results are given in Table 31.

The results revealed that there was significant increase in the yield of apples as a result of improved methods of pest management (Timely sprays recommend doses of pesticides and monitoring of pest) over farmer's practice of spray schedule. It was further observed from economic analysis that with the introduction of this intervention farmer's net income was increased by more than Rs. 50,000.00/ha: it contributed to increase net orchard income and the whole system was improved.

Table 31: AVERAGE YIELD AND ECONOMIC RETURN FROM APPLES UNDER IMPROVED AND FARMER'S PEST MANAGEMENT.

Particular	Improved pest management	Farmer's Practice
Average yield (kg/ha)	18705	12017
Gross income (Rs/ha)*	1,63,668	1,05,148
Cost of production (Rs/ha)	23238	15215
Net benefit (Rs/ha)	1,40,430	89,933
Added cost (Rs/ha)	8,032	-
Added income (Rs/ha)	50,497	-
Marginal cost benefit ratio	1: 6.29	-

*Price Rs. 8.75/kg

IMPROVING APPLE PRODUCTION THROUGH PRUNING, TRAINING AND PROPER PEST MANAGEMENT.

Orchards at three sites were selected and pruned in the month of February 1992. Spray against key pest were carried out as indicated in management of insect pest in apple orchards. The yield data and partial budgeting is summarized in Table 32.

The improved intervention of pruning method significantly increased the yield of apples as well as produced good quality fruits over un-pruned trees (farmers practice). It was further observed from economic analysis that with the introduction of pruning intervention, farmer's net income was increased over Rs. 25,000/ha. Ultimately it contributed to higher net orchard income.

Table 32: AVERAGE YIELD AND ECONOMIC RETURN FROM APPLE ORCHARDS (THREE SITES) UNDER PRUNING AND PROPER PEST MANAGEMENT AND UN-PRUNING AND FARMER'S PEST MANAGEMENT TECHNIQUES.

Particular	Improved Practice	Farmer's practice
Average yield (kg/ha)	42530	38690
Cost of production (Rs/ha)	17,715	10,515
Gross income (Rs/ha)*	3,72,137	3,38,537
Net benefit (Rs/ha)	3,54,422	3,28,022
Added cost (Rs/ha)	7,200	-
Added income (Rs/ha)	26,399	-
Marginal cost benefit ratio	1: 3.67	

*Price Rs. 8.75/kg

IMPROVING THE YIELD OF APPLE BY CONTROLLING BARK SPLITTING DISEASE.

For the control of this disease three copper based fungicides viz cobax, Trimiltox forte and captan were tried by removal of disease parts and then paste application V/S non removal and then paste application method and direct application through spraying the effected portion. The doses were as under:

1. Cobox: 500 gm per liter of water for direct application. 500 gm per 100 liters of water for spray.

2. Trimiltox

   Forte: 250 gm per liter of water for direct application. 500 gm per 100 liters of water for spray.

3. Captan: 200 gm per liter of water for direct application. 200 gm per 100 liters of water for spray.

The oozing of oil from the split bark was stopped, which is the results of effectiveness of fungicides compared to continuous oozing.

From results it is concluded that all the three chemicals have effectively controlled the bark splitting disease of apple. As regard the method of application it was observed that the cut or surgery method of application of fungicides was found more effective in controlling the disease as compared to pasting and spraying of fungicides on affected portions.

IMPROVING CUMIN YIELD BY CONTROLLING WILT DISEASE.

Trials were laid out at three locations in the target area, during Rabi 1991-92. The cumin seed was treated with Benlate and Topsin at the rate of 2.5 gm per kg of seed before sowing. The sowing was done by broadcasting in a well prepared seed bed. The results are given in Table 33.

Table 33: THE EFFECT OF BENLATE AND TOPSIN ON WILT DISEASE AND THE CUMIN YIELD AT KANAK DURING 1991-92.

Locality	Treatment	Disease plants (%)	Yield (Kg/ha)
Shamozai	Benlate	19	430
	Topsin	11	440
	Untreated	70	270
Rabi	Benlate	13	510
	Topsin	10	520
	Untreated	60	280
Sardar	Benlate	9	470
	Topsin	6	500
	Untreated	44	300
	CV.		5.23%
	Cost benefit ratio	Benlate =	1:5.4
		Topsin =	1:5.6

Data revealed that the disease ranged from 6-19% in treated plots while in untreated plots it ranged from 44 to 70%. The cumin seed planted after treatments with Topsin and Benlate gave considerably higher yield as compared to untreated seeds.

MAIZE PROGRAMME

About 4000 kg maize seed of improved variety (RV-1085) was planted by 150 farmers covering 270 acres in FSR target areas. On an average 124% and 62% increase in grain and stalk yield was obtained in case of improved technology. The results are given in Table 34.

Table 34: COMPARISON OF IMPROVED AND EXISTING VERSIONS OF MAIZE TECHNOLOGY IN GUJAR KHAN TEHSIL 1993.

Particular	Grain yield (kg/ha)	Stalk yield (kg/ha)	Plant fertility (%)	Plant density (No/ha)
Improved version	3184	12084	93	95100
Existing Tech.	1421	7921	67	152100
Increase (%)	124	52	39	-37
Sig. level	**	**	**	**
Cv (%)	22.8	29.9	16.3	18.4

In an other trial where improved variety, fertilizer, low density and deep tillage were tested together in order to examine the production potential of maize, the yields were improved upto 214 and 109%, respectively. The results are presented in Table 35.

Table 35: COMPARISON OF VARIOUS MAIZE PRODUCTION COMPONENTS IN GUJAR KHAN TEHSIL 1993.

Particular	Grain yield (kg/ha)	Increase over check (%)	Stalk yield (kg/ha)	Increase over check (%)	Plant fertility (%)	Plant density (ha)
V+F+D+DT	4464	214	15600	109	100	101900
V+F+D	3790	167	14500	84	102	88300
Existing Tech.	1422	-	7900	-	67	152100

V = Improved Variety F = Full dose of fertilizer
D = Low plant density DT= Deep tillage

FODDER PROGRAMME

Introduction of high fodder yielding, good quality and palatable mustard variety (S-9) for mix cropping in wheat produced 97% more fodder than the local variety with in-significant decrease in wheat grain and straw yields. This means without any extra input cost an additional income of Rs. 1770/ha was obtained by the farmers (Table 36 & 37).

Table 36: AVERAGE WHEAT AND MUSTARD (FODDER) YIELDS (KG/HA) DURING 1988-89 TO 1992-93 IN FATEHJANG AND GUJAR KHAN RAINFED AREAS.

Year	Mustard Fodder		Wheat			
			Grain		Straw	
	FP	IP	FP	IP	FP	IP
1988-89	7665b	9153a	1189	1147	1529	1447
1989-90	13362b	23719a	2626	2493	3426	2966
1990-91	6500b	16350a	4185	4145	7344	7200
1991-92	5520b	14120a	4034	4105	6129	6021
1992-93	6690b	13050a	2370	2240	5780	5560
Average	7767b	15278a	2881	2826	4842	4639

Table 37: AVERAGE NET RETURN FROM WHEAT AND MUSTARD FODDER UNDER DIFFERENT TREATMENTS (RS/HA) DURING 1988-89 TO 1992-93.

S.No.	Treatment	Gross Income	Input Cost	Net Income	Increase over FP
1.	Farmer's Practice	13366	4008	9358	1770
2.	Improved Practice	15142	4014	11128	-

Introduction of improved oats variety (PD2-LV65) to replace traditional fodder barley also generated an additional income of Rs. 4588/ha over the farmer's practices (Table 38). Being multi-cut, it provides green fodder during fodder deficit periods and greatly saves the mustard crop for seed and wheat for grain which are otherwise used for fodder.

Table 38: YIELD AND ECONOMIC BENEFITS WITH INTRODUCTION OF FODDER OATS.

Parameter	Farmer's practice	Improved practice
Fodder Yield (Kg/ha)	16467	3 .399
Gross Return (Rs/ha)	4117	9599
Production Cost (Rs/ha)	1089	1983
Net Return (Rs/ha)	3028	7616
Increase (Rs/ha)	-	4588

Note:- Average Green Fodder price during 1987-88 to 1992-93 was 0.25/kg at Farm.

In kharif 1988 and 1989 an improved variety P-76 of cowpea was introduced in wheat-fallow-wheat cropping system. This practice gave 92% more income per hectare over the farmer's practice.

Improved variety and production technology of sorghum was compared with farmer's practice in Fatehjang area during three consecutive years (1989-91). Green fodder yield of 34516 kg/ha was recorded under improved production technology while 17321 kg/ha of green fodder was produced under farmer's practice. This resulted in 93% additional income to the farmers over their own production technology.

OIL SEED PROGRAMME

In out reach testing, demonstration trials of soybean production technology were conducted during kharif season at farmer's fields in Fatehjang and Gujar Khan areas. Some newly developed soybean varieties, NARC-I, NARC-II, Swat-84 and Bregg were planted under rainfed conditions. Soybean was sown in the end of June/mid of July when the land is kept fallow by the farmers.

Crop matured and harvested in September. Land can be readily available for seedbed preparation for wheat sowing in coming rabi season. These results revealed that soybean could be grown in kharif in rainfed areas without any disturbance in wheat plantation. Therefore, a good opportunity was provided to the farming community to increase their income per unit area. Thus improved cropping system (wheat-soybean-wheat) will provide a suitable new package of production technology for farmers community of rainfed areas.

Rapeseed varieties (canola type) like Wester and Shiralee were planted in out reach programme in Fatehjang and Gujar khan areas. These varieties were planted in early October and harvested in April. This crop matured earlier than wheat and therefore farmers would have sufficient time for harvesting of wheat. That is why the farmers are adopting the cultivation of brassica (canola type varieties namely "Wester and Shiralee") in rainfed areas of Fatehjang and Gujar Khan. Secondly, farmers could use the extracted edible oil directly in their food as ghee which is highly desirable for human health due to the low contents of erusic acid and glucosinolate.

In wheat-fallow-wheat system on an average of four season (kharif, 1988, 1989, 1990 and 1991) the yield of rapeseed was 1500 kg/ha. Wheat yield after fallow was 2843 kg/ha. However, the over all net benefit from the improved system was more than the traditional system. The Additional income was Rs. 2881.00/ha. Similarly, in wheat-sorghum-fallow-wheat system, on an average of three season (spring, 1989, 1990 and 1991), the yield of sunflower was 1456 kg/ha, and wheat yield after fallow land was 3888 kg/ha. A net benefit of Rs.3651.00/ha was obtained through the improved farming system.

PULSES PROGRAMME

Average grain yield of mungbean over six sites was 852 kg/ha and straw yield was recorded as 3843 kg/ha. A net benefit of Rs.5215 was obtained by the farmer with a cost benefit ratio of 1:4.01 in Fatehjang Tehsil.

On an average maximum lentil grain yield of 1001 kg/ha and straw yield of 3048 kg/ha was recorded in improved production technology (Variety Mansehra-89, drill sowing, 2 bags DAP/ha and one spray of pre-emergence herbicide) as against farmers practice where local variety was sown by broadcast method, no fertilizer was applied and occasional weeding was done.

On an average, grain yields of 603 and 833 kg/ha and straw yields of 2661 and 2336 kg/ha were recorded in mungbean and mashbean, respectively. It means that production of mungbean and mashbean can be increased by introducing the improved varieties and practice over local variety which was sown by broadcast method, no fertilizer was applied and occasional weeding was done. Maximum net benefit of Rs. 3622/ha was exhibited by the improved variety of mungbean. Cost benefit ratio for this mungbean variety was calculated as 1:3.09. While minimum net benefit of Rs. 6180/ha was exhibited by the improved variety of mashbean. Cost benefit ratio for the mashbean variety was calculated as 1:4.47.

Highest grain yield of 1030 kg/ha and 1124 kg/ha in lentil and chickpea, respectively, can be obtained when the crops planted with the help of tractor mounted drill, application of 2.5 bags of DAP/ha at hoeing time and one hand weeding before flowering. Production of chickpea and lentil can be increased to a significant level by introducing the improve varieties (high yielding, short duration and disease resistant, and applying pulses production technology in Gujar Khan and other pulses growing areas.

Maximum net benefit of Rs. 14473/ha was exhibited by the improved variety of chickpea. Cost benefit ratio for the chickpea variety was calculated as 1:5.45. While maximum net benefit of Rs. 5097/ha was exhibited by the improved variety of lentil `Precoze'. Cost benefit ratio for the lentil variety was calculated as 1:5.5.

AGRO-FORESTRY PROGRAMME

Thirty six thousands saplings of multi-purpose tree species (MPTS) have been planted and distributed to more than thirty nine farmers. Out of 36000 saplings, 21000 saplings were planted under supervised programme. More than 300 farmers and school boys were trained in nursery raising, planting and post planting care techniques.

Multi-purpose tree nurseries comprised of about 20,000 MPTS have been established on the farmer's field on the principle of participating approach at Mora-Admal-Gojar Khan. About 10,000 plants were planted in Attock district.

Following multi-purpose tree species have been included in the nursery.

- Acacia nilotica
- Leucaena lencocephata
- Eucalyptus camaldulensis
- Zyziphus numulascia

Farmers meetings were arranged in order to popularize the concept of various Agro-forestry systems and importance of raising multi-purpose tree species.

LAND RESOURCES COMPONENT

Soil characteristics especially the chemical ones are dependent on a number of biotic and abiotic factors. Plant nutrients availability potential of soil may vary with the type of crop, fertilizer application regimes and other soil management

factors. One of the objectives of this project was to assess the status of various plant nutrients in soil under different interventions at farmer's fields.

Sowing of sunflower and soybean indicated no effect on soil pH and EC at 0-15 and 15-30 cm depth, after the harvest in a clay loam soil (Table 39). Continuous cropping resulted in the decline of soil phosphorus and nitrogen. The trend remained the same in spring and autumn seasons.

In case of mungbean, after harvest, soil pH and EC were slightly decreased resulting in comparatively higher availability of phosphorus and nitrate nitrogen.

Table 39: EFFECT OF VARIOUS INTERVENTIONS ON SOIL NUTRIENTS STATUS.

Particular	Crop	Depth (cm)	pH	EC (ds/m)	P (mg/kg)	NO_3-N (mg/kg)
Presowing	Sunflower	0-15	7.81	0.20	1.6	1.46
		15-30	7.64	0.18	1.5	1.40
Postharvest		0-15	7.94	0.15	1.28	1.70
		15-30	7.74	0.15	1.10	1.63
Presowing	Soybean	0-15	7.83	0.45	2.54	3.91
		15-30	7.93	0.35	3.42	4.03
Postharvest		0-15	7.58	0.35	1.52	2.60
		15-30	7.78	0.19	2.39	2.92
Presowing	Mungbean	0-15	7.99	0.22	0.85	2.64
		15-30	7.98	0.34	0.72	3.07
Postharvest		0-15	7.61	0.25	1.17	2.60
		15-30	7.72	0.13	1.03	2.66

ANIMAL NUTRITION PROGRAMME

In order to enhance the milk production complete mineral mixture was introduced in FSR Target area. An increase of 1.5 to 2.5 liters of milk was observed in 95% of cows and 87% buffalos supplemented with complete mineral mixture. The

reproductive efficiency of cows and buffalos was improved by 26 and 19%, respectively. The puberty age of the heifers (cows/buffalos) was reduced by 6-10 months. Overall body condition of all the animals was improved as a result of mineral supplementation. Net economic return of Rs.8.00 to 15.00/animal/day was achieved only as a result of milk in crease in lactating animals, while marginal rate of return also increased (1: 5.6).

Scanty information are available about milk production and its relationship to lamb's performance in grazing ewes. During first 3-4 weeks of lambs life, milk is very essential, and in this period correlation between milk intake and live weight gain is approximately 0.9. In a grazing situation like Fatehjang/Gujar Khan areas, supplementation with complete formula ration can increase milk production and consequently lamb performance.

The weaning weight of lambs was higher ($P<.05$) in supplemented groups compared with control (Table 40). No differences in weight change of lambs were detected among the groups supplemented either .5 kg ration daily or .75 kg on alternate day.

Average daily weight gain of lambs was greater ($P<.05$) from ewes receiving supplemental ration compared with those fed no supplement. Among the supplemented groups, daily weight gain tended to be higher in lambs from ewes fed .5 kg concentrate ration daily compared with those fed .75 kg ration on alternate day. However, the differences were non-significant. Lambs mortality was decreased ($P<.05$) in supplemented groups compared with control.

Table 40: EFFECT OF SUPPLEMENTAL FEEDING ON LIVE WEIGHT GAIN OF EWES AND THEIR LAMBS.

Item	Treatment[1]			
	Control	.5 kg/d	.75 kg/Ad	SE
Avg Weight of ewes, (kg).	31.6	32.8	31.7	1.5
Avg birth weight of lambs, (kg).	2.5	2.8	2.8	.3
Avg Weight gain of lambs, (g/d)	60b	87a	84a	2.9
Avg Weaning weight of lambs, (kg).	7.5b	10.8a	10.4a	.5
Mortality,(%)	12a	3b	3b	.4
Milk Production, (ml/d)	215	402	380	12.4

[1] Control = No concentrate supplementation;
.5 kg /d = .5 kg concentrate ration supplemented daily;
.75 kg/Ad = .75 kg concentrate ration supplemented on alternate day.

[a,b] Means in the same row bearing different superscripts differ (P<.05).

Partial budget for the supplemental feeding experiment is given in Table 41. The net benefit of lambs from ewes supplemented with .5 kg ration daily and .75 kg on alternate day is Rs. 304.00 and Rs. 307.00/lamb, respectively, while those for control group is Rs. 231.00/lamb. The total cost that vary is Rs. 63.00/lamb for .5 kg/d while it is Rs. 46.00/lamb for .75 kg/Ad supplemental ration.

Table 41: PARTIAL BUDGET ANALYSIS OF LIVE WEIGHT GAIN IN LAMBS FROM EWES FED DIFFERENT LEVELS OF SUPPLEMENTAL RATION.

	Treatments[a]		
	Control	.5 kg/d	.75 kg/Ad
Average weight gains (kg/lamb)	7.5	10.8	10.4
Mortality losses (kg/lamb)	0.9	0.3	0.3
Net weight gain (kg/lamb)	6.6	10.5	10.1
Gross benefit (Rs/lamb)[b]	231	367	353
Cost of feed (Rs/lamb)[c]	0	63	46
Total cost that vary (Rs/lamb)	0	63	46
Net benefit (Rs/lamb)	231	304	307

[a] Control = No concentrate supplementation.
.5 kg/d = Concentrate ration supplemented daily.
.75 kg/Ad = Concentrate ration supplemented on alternate day.

[b]Field price of undressed meat = Rs. 35/kg
[c]Field price of feed = Rs. 3/kg

ANIMAL HEALTH PROGRAMME

CHEMOPROPHYLACTIC EFFICACY OF IVERMECTIN AGAINST INDIAN GOAT WARBLES (Przhevalskiana silenus):

In the control group warbles were recorded on the back, belly, thighs and neck of the infested animals. First appearance of nodules was observed during mid November. The number of warbles per animal ranged from 1-44. The perforation in the skin by the larvae and their falling on the ground thereof started during the first week of December and continued till last week of January. By the first week of February all the infested animals were found free of infestation. The warble infestation rate in the control group (55%) during the current year was lower than the infestation rate recorded during last year. The control group may be attributed to the control measures adopted in the previous years. It may be concluded from

the present study that Indian goat warble fly can be controlled in Pakistan by strategic use of ivomec.

EFFECT OF DISEASE PREVENTIVE MEASURES (VACCINATION AND DEWORMING) ON THE PRODUCTIVITY OF SHEEP AND GOAT.

The results revealed that the average weight gain of animals, lambing %age and annual wool/hair production were higher in treated animals in both the group as compared to controls in both the species. Mortality rate was decreased by 100% in sheep and 167% in goats as a result of treatment. Annual hair production in goats was increased by 26% and wool production in sheep was greater by 18% in treated group compared with control. Based upon the results of the present study it may be concluded that vaccination and deworming have a definite effect on the productivity of sheep and goats and the farmers may be motivated to adopt these practices for the optimum production of their small ruminants.

RURAL POULTRY PRODUCTION

Realizing the importance of training need and technology transfer for rural women, improved poultry production training programme was started in October, 1989 which was launched on the basis of results of diagnostic survey, that women are facing the problems of high mortality and low poultry production due to the lack of disease preventive and management practices. The aim of the project was to involve rural women in income generating activities and to increase the level of net income of women farmers. This training programme was developed in collaboration with Poultry Research Institute, Rawalpindi.

Fumi poultry was introduced along with technical knowledge regarding poultry diseases, poultry hygiene, preventive vaccination and treatment of parasitic infections.

Statistical information revealed that this programme has left very positive effects on the poultry production at household level. The poultry numbers has increased from 2 to 6 per household i.e. before intervention, on average 2 birds were reared/household but now it has gone upto 6 in numbers. Mortality has been decreased from 11% to 2.4%. Use of vaccine is 100% because almost all the farmer's are using this package.

As fumi breed lays eggs almost every day, it has greatly benefitted its holders. On average women are getting Rs. 22.0/bird/month as net benefit Table 42.

Table 42: COST AND RETURNS OF HENS REARED BY SAMPLE GROUP FOR 6 MONTHS.

Particular	Trained women*		
	Qty.	Rate (Rs)	Amount (Rs)
Eggs gross income (dozen)	56	30	580
Wheat, maize + others (kg)	294	3	882
Vaccination (times)	3	1.50	4.50
Production costs	-	-	886.50
Production cost/bird/month			24.7
Income/bird/month			46.7
Benefit/bird/month			22.0

*Six hens/trained women

Project has not only enabled them to add something to their income but it has also left positive effect on their dietary habits. Through this programme rural women got confidence and motivation to accept any change which could have better effect on their life.

TRANSFER TECHNOLOGY UNIT, NARC

Five entrepreneurs were established throughout FSR Gujar Khan target areas to channelize sustained availability of key inputs-seed, pesticide, feed, etc. About 3400 kg seed of improved varieties of maize, wheat, chickpea, oats and canola was distributed among the farmers during 1993-94 through these entrepreneurs.

About 1500 plants of mulberry were distributed among the farmers to promote sericulture activities through out the FSR target areas.

Crisp making technology for groundnut has been developed which would be extended to the resource poor farmers to raise their farm income.

Two colloquial and five fields days pertaining to different production technologies of crops were organized in different villages through out FSR target areas.

FSR PUBLICATIONS/TRAININGS

WORKSHOP PROCEEDINGS:

- Farming Systems Research in Pakistan, Recent Development and Trends, 1987.
- Farming Systems Research in NWFP, 1987.
- Rural Women in Pakistan Farming Systems Research, 1988.
- Farming Systems Research Project, FSR Institutionalization Conference Quetta, 1989.
- Rural Women in Farming Systems Research NWFP, 1990.
- Farming Systems Research Trial Designs, 1991.

PAPERS:

- Income Generation Schemes for Rural Women, 1989.
- Farming Systems Research Institutionalization (Position Paper).
- Diagnosis of Crop and Livestock Production Constraints and Potential Research Opportunities in Kanak Valley, 1991.

DIAGNOSTIC SURVEY REPORTS:

- Farming Systems Research Target Area Characterization (District Kalat), 1988.
- Rural Women in Farming Systems Research, 1989.
- Farming Systems Research Target Area Characterization (Mansehra, Hazara Division).
- Socio Economic Profile of FSR Target Area in Fateh Jang Tehsil of Rainfed Punjab, 1990.
- Rural Women in Kanak Valley, 1992.

CONSULTANCY REPORTS:

- Farming Systems Research Management of Agricultural Research and Technology Project, 1989.
- Farming Systems Research NARC Master Plan Implementation Report-1, 1990.
- Assessing the Impact of Farming Systems Research in Pakistan, 1990.
- Farming Systems Research, 1990.
- Farming Systems Reserach & NARC Master Plan. Report III, 1991.
- Statistical Support for Farming Systems Research, 1991.
- Farming Systems Research, 1992.
- Farming Systems Socio Economic Research in Pakistan.
- Data Collection and Economic Analysis.

OTHER REPORTS:

- Farming Systems Research Project Activities in Shah Kot, 1987.
- Livestock in Pakistan, Farming Systems Research, 1987.
- Farming Systems Research in Pakistan - Recent Developments Trends, 1989.
- Sustainable Agriculture & Resource Conservation in Pakistan, 1990.
- Farming Systems Research Extension Manual.
- Farming Systems Research Project Balochistan Unit, 1991.
- Farming Systems Research Project Some Significant Improvements in Crop, Livestock Systems Through FSR Methodology in Shah Kot Project.
- Plant Available Moisture in Potohar Barani Area.

- Rural Women Poultry Keeping at Fateh Jang, 1992.
- Farming Systems Research Future Strategies, 1993.

FSR FACT SHEETS:

- Cultivation of multicut Sadabahar fodder.
- Cross pollination in apple production.
- Pest-management on household grain storage.
- Wheat sowing after rice by zero tillage.
- Mongbean intercropping in wheat and rice.
- Rural poultry keeping.
- Urea treatment of crop residues.

FSR IN PICTURES:

- Farming systems research Shahkot area.
  MAIZE VARIETAL INTERVENTION
- Farming systems research Shahkot area.
  THE LEUCAENA INTERVENTION
- Farming systems research Shahkot area.
  OUR VISITORS IN PRINT MEDIA
- Farming systems :esearch Shahkot area.
  A VISIT TO THE PROJECT AREA

Farming systems research project area Shahkot/Proka, 1989.

FSR A/V MODULES:

- Urea treatment of wheat straw.
- Rrual women on agricultue.

- Safe handling of pesticides.
- Mott grass = A multicut green fodder.

TRAINING COURSES.

LIST OF FSR-SPONSORED IN-COUNTRY TRAINING COURSES
July 1986-August 1993.

S. No.	Description of Course	Duration days	No. of Participants
1986		Days	
1.	Orchard Management	10 (Feb)	31
2.	Home Gardening for Ladies	5 (Apr)	39
3.	Range Management and Forage Production.	12 (Apr)	31
4.	Worshop on On-Farm Maize Research with a Farming Systems Persspectives; Diagnostic Survey.	9 (Jul)	18
5.	National Workshop on Res. Extension Linkages for effective Technology Transfer.	5 (Oct)	53
1987			
6.	Technology Transfer for Extension Workers.	26 (Jan)	33
1990			
7.	Worshop for Women Scientists In Agriculture Research.	4 days	40

8.	On-Farm Livestock Trial Workshop.	3 days	10
1991			
9.	FSR, Orchard Management ARS, Dohdial.	5 days	34
10.	Enrichment/preservation of crop residuse at farm level-UAF.	5 days	12
11.	Farmers Training in Animal Health-UAF.	30 days	-

BENEFITS TO THE FARMERS

During the diagnostic survey it was noticed that most of the farmers of the target areas were not aware of the approved technologies and thus they continued their traditional practices with the result that their farm production was much lower than expected. After the start of FSR project and working together with FSR scientists the farmer's learned about the improved technologies to increase farm production and better utilization of available resources. Following is the brief summary of benefits to the farmers.

Introduction of soybean in wheat-fallow-wheat system increased the net farm income upto Rs. 6000/ha. Similarly by replacing wheat with rapeseed variety (canola type) farm net income was increased from Rs. 3500/ha (from wheat) to Rs. 6000/ha.

With the increase of cropping intensity (wheat-sunflower wheat instead of wheat-fallow-wheat) farmers have obtained extra income from Rs. 2881 to 3651/ha.

About 1038 thousand hectare of fallow land is available in rainfed area of Pakistan, which can be brought under sunflower and the farmers can be benefitted tremendously.

Farmers started growing pulses in the barani area again, while they were in view that pulses are risky crops being susceptible to fungal, bacterial and viral diseases and are less lucrative farming business than cereals.

Fertility and productivity of soil in barani areas has improved as food legumes fix atmospheric nitrogen and improve soil fertility thereby saving millions of rupees of farming community, which otherwise have been spent to meet the nitrogenous fertilizer.

Introduction of high yielding and short duration variety of mungbean in various cropping systems has raised the farm income and has economize the limited irrigation water source.

Sesame cultivation was introduced in Shahkot area during 1988. The data regarding the adoption rate of this intervention was recorded for the subsequent years. The analysis of the data revealed that amongst the 46 farmers interviewed about 15% adopted this intervention during 1989, and 48% in 1990. This intervention was warmly accepted by the farmers due to its suitability to marginal land and moreover the land after wheat harvesting remained fallow due to limited irrigation water. The special merits of the sesame cultivation were that it needs comparatively less water and add fertility to the soil.

Direct sowing of wheat seed in rice stubbles and broad casting of seed in flooded field after rice harvesting has enabled the farmers to plant wheat in time. Consequently yield and net return has increased tremendously.

Adoption of cotton-wheat relay cropping technology increased the income of farmers tremendously. Its adoption increased rapidly as four farmers in 1990-91 to 74 and 111 farmers in 1991-92 and 1992-93, respectively. The increase in area under this intervention showed same trend and it increased form 5.5 acres in 1990-91 to 235 and 5918 acres in 1991-92 and 1992-93 respectively. The rapid increase in number of farmers adopting this technology and area showed its suitability to the farmers conditions and hoped that it will spread very soon in the cotton zone of the Punjab province.

With the introduction of pure seed of various crops the crop yields and farm income of the farmers have increased manifold. Farmer's income have also increased by inter-cropping of onion in sugarcane and planting wheat by zero tillage drill in onion-fallow-onion system.

Farmers also benefitted from introduction of multicut fodder-sorghum `Sadabahar' hybrid and Mott grass. The milk production of their cattle were increased due to these fodders.

Farmers are now fully aware of spraying their crops on scientific lines. They are now using the right type of insecticide and adequate spray coverage to crops. Realizing the benefits of new agricultural interventions, now the farmers don't hesitate to visit the extension officers for getting advice for improving the output of their resources.

Farmers now get training in pest scouting for determination of economic injury level. Farmers were also trained in producing the pure seed of different crops and store that seed for plantation in next season. They also benefitted by selling pure seed on higher prices.

Farmers are successfully maintaing their block plantation as well as various multi-purpose tree trials demonstrated by Agro-forestry management systems. These plantation will help the farmers in raising their income and improving the soil.

Economic losses due to mortality of the kids/lambs were reduced (12% vs 3%) as a result of supplemental feeding to the lambs in the FSR target areas.

Awareness among the farmers has been created regarding supplemental feeding during last few weeks of pregnancy to improve the production performance of sheep/goats and their lambs/kids.

Farmers have become confident about the use of mineral mixture, as the milk production was increased and calving interval was reduced. About 5,000 farmers are using mineral mixture in the area.

Vaccination against infectious diseases and deworming against endo/acto parasites have been adopted at large scale. More than 10,000 farmers are regularly vaccinating and deworming their livestock.

LESSONS LEARNED

In FSR approach, scientists and farmers work together to verify and adopt experiment station technology to specific agro-ecological conditions. Coordination between extension, research and agricultural education is enhanced, while feedback on research needs and adoption is swift, dynamic, and effective. The lesson learned and difficulties encountered during execution of FSR programme are briefly discussed below.

1. Small and fragmented land holding owned by the majority of farmers particularly in rainfed areas is great hurdle in managing the farm properly.

2. The improved and validated technology can effectively be transferred to the end users and adoption can be made rapid through FSR farmers participatory approach.

3. FSR approach has been instrumental in creating team spirit among the multidisciplinary scientists working together.

4. Any technology developed at the station may be communicated to the farmers through extension agencies. However, farmer's confidence in the usefulness and effectiveness of the technology can accelerate the adoption process.

5. While working with the farmers it needs to help in mind that their daily routine and practices should not be disturbed. Any new technology, which farmers are initially reluctant to accept it is found, can be made acceptable by making it more compatible with farmer's existing systems. An abrupt and sudden switch over from old to new technology generally, do not bring encouraging results.

6. Little incentive in the form of farm inputs, more attention of farmers for managing the interventions at farmer's fields.

7. Diagnostic surveys play a key role in planning development projects. Non-availability of social scientists especially female workers remained a question and this created some problems in carrying out diagnostic and other activities in the project areas.

8. Collaboration of scientists of different disciplines working as FSR team remained a problem throughout the project period because they had their own administrative problems. Moreover the scientists of different disciplines had to work in FSR in addition to their own duties assigned to the post they were working against.

9. Delay in budget release created serious problems in timely purchasing the inputs. Although the sanctions were accorded timely but releases were delayed and very often scientists had to meet and use inputs from their departmental budget. For efficient execution of the programme timely release of funds is very essential.

10. There is a shortage of livestock extension staff for the development of this sector. Therefore, the livestock farmers may be imparted para-veterinary training so that they could give first aid treatment to their livestock by themselves.

11. Seed dissemination from farmer to farmer i.e. horizontal seed distribution is the most effective and quick method of seed dissemination among the farming community. This system of seed production and dissemination need to be extended intensively throughout the country.

12. It was learned that when comparison of improved and local species/interventions was made at farmer's fields, they accepted and adopt the technology quickly.

13. At farmers' fields interventions should be kept very simple and of minimum treatments. So that tangible results could be achieved.

14. Most of the farmers are loosing their interest in farming because of high input cost, uncertain agro-climatic conditions and poor market infrastructure.

APENDIX I

Summary of number of farmers, hectares & animals covered and economic benefits earned through FSR interventions.

Unit	Number			Economic benefit (Rs. 000)
	Farmers	Hectares	Animals	
AARI, Faisalabad	7508	8096	-	9781
AU., Faisalabad	6847	688	8312	8316
SAU, Tandojam	1158	1385	-	8226
ARS, Dhodial	1653	1612	3800	6029
ARI, Quetta	1949	2273	3600	17383
NARC, Islamabad	2206	2040	9000	6750
	21321	16094	20712	56485

Appendix I

FSR validated interventions and economic benefit Shahkot/Gojra, AARI, Faisalabad.

S.No. Intervention	Benefit over farmers practices (Rs/ha)	Hectare covered	Total benefit (Rs.000)	Farmers covered
1. Sesamum in wheat-fallow-wheat system.	8,000	184	1,472	209
2. Early planting wheat:				
* as relay cropping in cotton.	200	6,000	1,200	3,000
* as direct drilling after rice.	1,605	860	1,380	500
3. Direct seeding of rice on farmer fields.	1st year	-	-	-
4. Mungbean in wheat-rice system.	2,969	276	819	119
5. Introduction of lentil.	2,083	180	374	78
6. Chemical weed control on:				
* Carrot crop.	11,146	312	3,477	267
* Peas crop.	5,498	180	989	50
* Wheat crop.	674	104	70	79
Total:		8,096	9,781	7,508

Appendix I

FSR validated interventions and economic benefit
Proka, University of Agri., Faisalabad.

S.No.	Intervention.	Benefit over farmer practices (Rs/ha)	Hectare Covered	Total benefit (Rs.000)	Farmers covered
1.	Pure seed of breseem.	5,088	192	976	185
2.	S.S. Hybrid.	13,399	224	3,001	199
3.	Mott grass.	12,356	272	3,361	6,000
	Total:		688	7,338	6,384
		Rs./10 Animal/ annuam	Animals Covered		
4.	Mineral supplementation.	12,360	196	684	50
5.	Supplemental feeding.	3,490	116	70	96
6.	Deworming of sheep.	610	4,000	224	317
	Total:		4,312	978	463
	Grand Total:			8,316	6,847

Appendix I

FSR validated interventions and economic benefit, Hala/T.M. Khan SAU Tandojam, Sind.

S.No.	Intervention.	Benefit over Farmer practices (Rs/ha	Hectares Covered	Total benefit (Rs.000)	Farmers covered
1.	Intercropping of onion in sugarcane in comparison with sole sugarcane crop.	18,814	324	6,095	297
2.	Improvement in wheat yield through improved agonomic interventions (seed + fertilizer).	4,936	260	1,283	185
3.	Pure seed of IRRI-6 with improved practices.	1,302	292	380	221
4.	To verify and assess the behavior of recommended doses of fertilizer in rice crop.	765	197	150	188
5.	Inclusion of lentils in cotton-wheat system to economize the use of irrigation water.	987	215	212	192
6.	Introduction of zero tillage drill in onion-fallow-cotton, cotton-wheat and rice-wheat systems.	1,100	97	106	75
	Total:		1,385	8,226	1,158

Appendix I

FSR validated interventions and economic benefit Pakhal valley Dhodial, Mansehra.

S.No.	Intervention.	Benefit over farmer practices (Rs/ha)	Hectare Covered	Total benefit (Rs.000)	farmers covered
1.	Soybean introduction.	4,000	224	896	311
2.	Maize soybean rotation instead of maize-wheat.	2,000	336	672	229
3.	Improved maize variety.	2,000	356	712	400
4.	Compatible pollen application to improve fruitfulness in apple.	6,000	368	2,208	317
5.	Weeds control in field crops.	875	328	287	297
	Total:		**1,612**	**4,775**	**1,554**
		Rs./10 Animal/ annum	**Animals Covered**		
6.	Flushing of yearling ewes for early fertility.	3,300	3,800	1,254	99
	Total:	**3,300**	**3,800**	**1,254**	**99**
	Grand Total:			6,029	1,653

Appendix I

FSR validated interventions and economic benefit Kanak valley ARI, Balochistan.

S.No.	Intervention.	Benefit over farmer practices (Rs/ha)	Hectare Covered	Total benefit (Rs.000)	Farmers covered
1.	Introduction of improved onion production technology (variety + fertilizer).	11,699	244	2,854	230
2.	Introduction of improved potato production technology (variety + fertilizer).	8,723	324	2,826	217
3.	Introduction of improved wheat variety (Pak-81) along with optimum fertilizer doses.	3,775	408	1,540	398
4.	Pest management intervention on apple crop.	20,625	196	4,042	210
5.	Pruning intervention on apple crop.	13,585	332	4,510	215
6.	Split bark disease of young apple orchards.	2,250	356	801	319
	Total:		**2,273**	**16,573**	**1,589**
		Rs./10 Animal/ annuam	**Animals Covered**		
8.	Effect of health coverage and supplemental feeding during breeding and lambing on performance of ewes.	2,250	3,600	810	360
	Grand Total:			**17,383**	**1,949**

Appendix-I

FSR validated interventions and economic benefit, Fatehjang/Gujar Khan, NARC, Islamabad.

S.No.	Intervention.	Benefit over farmer practices (Rs/ha)	Hectare Coverd	Total benefit (Rs.000)	Farmers covered
1.	Improved lentil variety + optimum fertilizer use.	5,736	80	458	75
2.	Improved sorghum variety and fertilizer.	2,823	256	722	225
3.	Comparison of improved mustard variety with local intercropped in wheat.	2,501	232	580	100
4.	Improved maize variety.	1,209	900	1,088	635
5.	Soybean in wheat-fallow-wheat system.	6,622	140	927	75
6.	Mungbeab in wheat-fallow-wheat system.	3,327	180	598	105
7.	Sunflower in wheat-fallow-wheat system.	2,746	252	691	159
	Total:		2,040	5,064	1,374
		Rs. per 10 animals/ annum)	Animals Covered		
8.	Vaccination and deworming of goats.	1,130	2,500	282	85
9.	Deworming and vaccinatio of sheep.	1,470	3,000	441	91
10.	Flushing of sheep and goats.	2,180	1,500	327	76
11.	Women poultry production.	1,000	-	136	80
12.	Mineral suppplementation.	2,500	2,000	500	500
	Total:		9,000	1,686	832
	Grand Total:			6,750	2,206